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FOURTEEN YEARS AGO.

With the present issue of THE ELECTRICAL WORLD closes the fourteenth year of the paper's existence. In March, 1874, the little *Operator*, out of which the present journal has grown, was started as an humble but earnest exponent of telegraphic principles and practice. It would very willingly have assumed a larger mission, but it had to be content with the field as it then was, and it made up its mind to develop that department to the utmost, anyhow. But that was only the beginning of electrical applications, and the paper soon discovered new opportunities of work and advocacy, and grew with the growth of the art, until at last the radical change in name and almost every other element became necessary. Up to that point the paper's circulation and authority had naturally been rather limited, but then began the journalistic career that has given THE ELECTRICAL WORLD its preëminence in the department of special work that saw its early pioneer efforts and now witnesses its wide range of representation and influence. A city is frequently judged by its newspapers, and it affords us profound gratification to know that THE ELECTRICAL WORLD is, in the same manner, everywhere accepted as essentially illustrative of the splendid development of electrical art and science in America. No one, indeed, can take up our present number, of **72** pages—far and away the largest issue ever seen of any electrical journal—without at once realizing the fact that the field is immense, and that THE ELECTRICAL WORLD covers it, faithfully and fearlessly, knowing neither East nor West, dealing independently, impartially and courteously with all, and ever seeking to advance the common interests of the profession and its allied industries. The paper will begin its fifteenth year, next week, under different auspices and conditions from those it had to contend with in 1874, but the same ideas and principles will rule its policy and actions, and it will go forward to the new and larger responsibilities strengthened by the support of countless old and new friends, whose help has always been appreciated, and never more than it is to-day.

Lighting the Hoosac Tunnel. THE task of lighting the big Hoosac Tunnel was not one to be easily carried out, and we think our article this week on the plant and the various methods employed will be studied with much interest. Our illustrations convey a very graphic idea of the novel features of this somewhat unique undertaking.

The New Plant at St. Paul, Minn. WE illustrate in this issue the fine new electric light station that has recently been constructed and equipped at St. Paul, Minn. The noteworthy point about the plant, beyond the methods used in power transmission, is that it is put in for a gas company. Not long since, the man who prophesied that gas companies would be among the best customers for electric light apparatus would have been laughed to scorn, but he would have been entirely safe in his prediction. Here is proof of it.

Stirring Up the West. IT is not generally supposed that the West requires much stirring up, but if it does, electricians are beyond question the people best qualified to try their hands at the operation, and just now they are engaged on it. As a preliminary to the meeting at Chicago, the Edison companies have been in session at Kansas City, where they have been occupied educating the Southwest in electrical possibilities. The special telegraphic dispatches from our regular Kansas City correspondent will be found to contain a lively and interesting account of the meeting there.

Synchronous Telegraphy. IN the interesting paper read before the American Institute of Electrical Engineers last week, Lieut. F. J. Patten brings out what might be called the salient feature of his invention, which, as he says, consists in the fact that he employs as synchronizing devices machines which are in themselves not isochronous, and the action of which is therefore dependent entirely one upon the other. Hence it differs essentially from former systems in which synchronism was sought to be obtained through maintaining two apparatuses in unison, by correcting any differences which might occur in their normal rates of independent operation. This is certainly a notable step in advance, and may lead to an extension of multiplex telegraphy which it has not heretofore enjoyed.

The Chicago Convention. OUR present issue will be delivered and read in Chicago while the convention is in progress, and, like the meeting itself, will be taken to be typical of the growth of the great industry brought so forcibly to the attention of the metropolis of the West. The programme we have already published, together with the other announcements, shows that the convention will be of unequaled magnitude and of unusual interest. Our Bulletin will be issued in the ordinary way while the convention is in progress, and we have no doubt that it will be as heartily appreciated, as it has been before at the various meetings. In the meantime, we can only wish the members and their friends a very happy gathering, that will have the effect of stimulating electrical development in the vast section of country that looks to Chicago for instruction and guidance.

Electricity in the Flour Mill. THE uses to which a new source of power can be applied in old situations is no better exemplified than in the account given on another page of the varied applications which have been found for electricity in the great Pillsbury mills at Minneapolis. With the early introduction of dynamos intended primarily for general illumination it was soon found that this system of illumination could be applied to other special work with marked beneficial effect. But in addition to lighting the current has been put to other uses, such as the ringing of bells and the operation of fire alarms. And not the least interesting and important new departure is its application to the heating of an oven for the raising of dough for the flour-tester. It would appear, however, that there is still another and wide application of the dynamo current here in the running of electric motors so as to avoid the use of belting from floor to floor. The article in another column hints at the troubles encountered, which necessitate the constant employment of a force of millwrights, and we think that much of this could be avoided by the application of motors. The description of a successful substitution of belts by motors in our last issue affords ample proof of the feasibility of the method. With the prime motive power all concentrated in one place, and with current and motors for distribution, the expenses of operation might be considerably reduced. We would be greatly pleased to see the Pillsbury mills the leaders in their field in this respect, and hope that the managers may deem the system worthy of a trial. It will meet their every want.

Edison Central Stations. A FEW weeks ago we laid before our readers a very full article on the new Edison stations in this city. In our present issue, we supplement that by a timely article of like character on the Edison station in Chicago. There are many points of contrast between the two plants, and in each instance it is seen that a number of difficult problems as to location of station, size of steam and electrical units, grouping of control apparatus, division of labor, etc., had to be met, and the manner of their solution certainly invites to praise. The conditions are often so new that no precedent can govern, and yet much depends upon the lessons taught by experience with the earlier stations where cruder apparatus has been in use. Central station construction is, in fact, a new branch of engineering, and so far as this country is concerned, Mr. J. H. Vail, the general superintendent of the Edison Company's engineering department, is entitled to a very large amount of credit for the example of skillful work that he sets to electrical engineers and others in the profession. He may fairly "point with pride" to such stations as those in New York and Chicago as brilliant examples of how to do it, and he has well won the high reputation he enjoys as an expert in this important field. Nothing is more encouraging in the electric lighting industry than to find so much first-class talent devoted to the construction of magnificent new stations, and then to see them intrusted to trained engineers able to carry on the work and make a technical and financial success of it.

Armature Construction. THERE was a time in electric lighting when the burning out of armatures was of frequent occurrence, and, indeed, constituted one of the principal items of maintenance of the dynamo. Happily this state of things no longer exists in the same degree; but the fact nevertheless remains that armatures do still occasionally give up the ghost without apparent cause. In seeking for an explanation of this, Mr. H. F. Watts claims to find the origin of the trouble in the constuction of the armature itself, and he contends that it carries within it the elements of its own destruction. His reasoning is certainly correct when he asserts that a tremendous pull must be exerted between the field magnets and the currents circulating in the wire, and that if sufficient means be not provided for maintaining the wire in position, occasions will arise when this pull will cause a movement of the wire and a displacement of the insulation. Then it is only a question of time when a short circuit and a consequent burn-out will occur. Mr. Watts points out the weakness of most armatures in this respect, and the small protection which the band wires with which most of them are provided affords; and he sees in the Brush type of armature the only one in which this defect is absent. We think, however, that Mr. Watts has not given the field of armature construction as thorough a survey as the question demands. It will be remembered that some time ago we described machines, among them the Wenstrom and Oerlikon, in which the wires were entirely embedded within the iron of the armature. This construction evidently also avoids the difficulty indicated by Mr. Watts. Nevertheless, the remarks of the critic are applicable to the construction of quite a number of armatures in use at present, and if, as seems probable, the cause of deterioration pointed out exists, means might well be provided to remove it.

The Kester Electric Motor.

There has been recently brought out by the Kester Electric Company, of Terre Haute, Ind., a system of electric lighting and a new motor which present some novel features. Our illustrations, Figs. 1 and 2, show the four-pole motor designed by Mr. J. F. Kester, the electrician of the company.

The main feature of this machine is the open coil armature illustrated in Fig. 3, the core of which is built up of discs supported upon a brass tube and held firmly in position by end-plates screwed upon the shaft. The coils, instead of being wound in a plane through the shaft, are wound as chords to the circumference, 8, 12 or 16 coils being placed on the armature according to requirement. The coils are so connected that the current has four paths through the armature, giving a large torque and permitting of the use of a current twice as great as in the ordinary two-pole machine.

The constant potential motor is shunt wound and is claimed to show no change of speed from full load to no load.

The speed of the constant current motor is regulated by a novel centrifugal governor, the entire governing apparatus for a 5 h. p. motor weighing, it is said, less than three ounces; the governor is adjustable, so that the speed of the motor can be changed at will and kept constant for all loads. The governing is not effected by changing the magnetization of the field, and therefore is not accompanied by sparking at the commutator. The commercial efficiency of the incandescent dynamo is claimed to be 92 per cent., and that of the motors 90 per cent.

Annual Report of the Westinghouse Electric Company.

The annual meeting of the stockholders of the Westinghouse Electric Company was held at Pittsburgh on Feb. 12. The election of Directors was, however, postponed for 60 days, in view of the fact that important negotiations are pending with reference to the company's business in England, where large orders have already been received, and also with reference to the immediate business of the company in this country. As the company has recently secured important acquisitions in the East, it was impossible at this time to make a complete report.

Mr. George Westinghouse, Jr., President of the company, presented a statement to the stockholders, in which he said:

"The business during the past year has been prosperous, and the earnings up to December 31, were more than sufficient to pay the usual quarterly dividend of 1½ per cent. During 1888 the company acquired by lease the control of the Consolidated Electric Light Company and the Sawyer-Man Electric Light Company, and the company now owns $1,235,000, par value, of the capital stock of the Consolidated Company, the capital of which is $2,500,000. The earnings from these two companies for the first quarter have been sufficient to pay the rental. In November 1888, the company acquired the capital stock ($135,000) and outfit of the Waterhouse Electric and Manufacturing Company, together with valuable inventions.

"In January an agreement was entered into with the principal owners of the United States Electric Lighting Company whereby this company purchased seven-fifteenths of the stock of that company (capital, $1,500,000), and whereby that company was re-leased to the Westinghouse Company.

"By the acquirement of the control of the Consolidated and United States companies the Westinghouse Company has secured a favorable position with reference to patents, having now the exclusive rights under the Sawyer-Man patents and numerous other valuable inventions. Already the case, as against the Edison Company licensee, the McKeesport Light Company, for infringements of the Sawyer-Man patents, has been before the United States courts for an argument for the fixing of an early date for a hearing, and it is the determination to push the case to a final hearing, believing that the patent in question can be sustained, greatly to the enhancement of the property and rights of this company.

"The orders received for central station apparatus since the 1st of January aggregate a capacity of 50,000 16 c. p. lights. Taking the lamps and details generally into consideration, the average price for each 16 c. p. light capacity is $8. The number of lamps sold by the Sawyer-Man Company in January was 92,000, while the United States Company for the same period sold 50,000 lamps. The three lamp factories are now capable, with the present machinery, of producing at least 18,000 lamps per day."

FIG. 3.—ARMATURE OF KESTER MOTOR.

Uniform Specifications for Wiring Buildings.

BY A. R. FOOTE.

In THE ELECTRICAL WORLD of Jan. 19, "System" raises some very pertinent questions regarding "Wiring Buildings by Contract." I know of other cases exactly similar to the one he mentions. My attention has been called to this subject from various points of view. It appears to me that the electrical industry has now reached that point of development which should enable it to formulate certain rules for the wiring of buildings, which could be made the standard of the manner in which such work should be done, and the basis of contracts for having it done throughout the country.

Architects have such rules for their guidance in drawing specifications for plumbing, steam heating and gas lighting, and why not for electric wiring? The greatest possible requirements of a building for light by electricity can be determined from the plans as well as for light by gas. Would it not be to the interest of the electrical industry to furnish specification forms with proper rules, which will enable architects to make their contracts in the way best calculated to secure the electric service of the building in the best manner known to the art? Such specifications would of course be approved by the boards of underwriters. When the work was finished, if done according to specifications, it would be sure to be approved by the inspector of the board of underwriters.

The assumption that a building can be so wired that any system or apparatus can use it, appears reasonable, and it is certainly desirable that it should be so. While it is probably true that the wiring for one system can be done a little more economically than for some other, the difference in cost for a single building cannot be very great, and the advantage of having a building wired so that it may be used by more than one system is a decided one.

Another advantage in having a uniform standard and specifications for wiring will be found in the fact that it will place all contractors on a well defined basis in making their bids. Each contractor will be required to fulfill the same requirements in the same way. When this is done contractors and the public will be saved from the competition of the uninformed or dishonest bidder, who makes a low price for his work, either not knowing what the requirements really should be or not intending to do it in the best way.

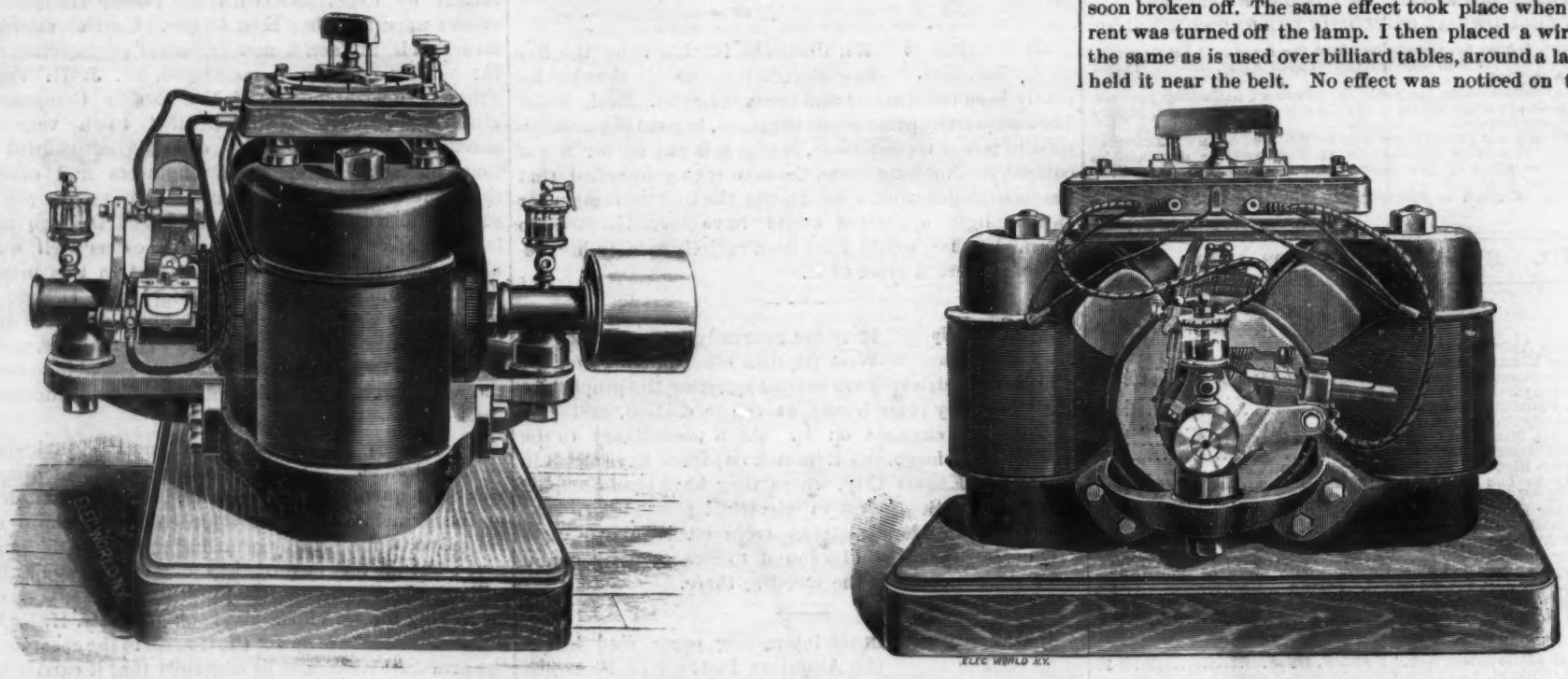
A demand to have buildings wired for electric service during construction in advance of the installation of central stations or plants from which the service may be obtained, is a good omen of the confidence felt by the public in electric lighting. Such demands will be greatly encouraged by architects if they are supplied with specifications, forms and rules which will enable them to know they are doing the right thing in using them as the basis of their contracts.

In view of the importance of this subject and the many benefits to be derived from well considered action, I ask, Is it not desirable to have the National Electric Light Association appoint a committee to investigate the question in all its bearings, and, if found practical, recommend specification forms and rules, to be furnished to architects, contractors, insurance boards, and inspectors, thus establishing a uniform standard for inside wiring throughout the United States?

Static Electricity and Incandescent Lamps.

BY C. S. BOWIE.

Not long ago I was called to look after some lights in a paper mill, where it was claimed the lamps were very short-lived. I found them to be a group of five situated around the calender rolls. As these rolls generate a great deal of frictional electricity, caused by the friction of the dry paper as it goes over them, it led me to believe that this was the cause of the lamps burning out so soon. In order to see what effect frictional electricity had on an incandescent lamp, and also to find a remedy for the above case, I held a lamp and socket, connected with a cord and attaching plug, near a dry, fast running leather belt. As soon as the lamp was placed near the belt, the carbon began to vibrate violently—so violently that it was soon broken off. The same effect took place when the current was turned off the lamp. I then placed a wire guard, the same as is used over billiard tables, around a lamp, and held it near the belt. No effect was noticed on the light or carbon afterwards. Wire guards were then placed around the lamps by the calenders, and since then there has been no complaint.



FIGS. 1 AND 2.—THE KESTER ELECTRIC MOTOR.

A Statement About Copper.

C. Kirchhoff, agent of the United States geological survey, has submitted a preliminary statement of the production and consumption of copper in the United States in 1888. The production is given as follows: Lake Superior, 86,404,993 pounds; Arizona, 31,797,300 pounds; Montana, 97,897,968 pounds; New Mexico, 1,681,271 pounds; California, 1,170,021 pounds; Colorado, 1,221,100 pounds; Utah, 2,181,047 pounds; Wyoming, 232,819 pounds; Nevada, 50,000 pounds; Idaho, 50,000 pounds; Maine, New Hampshire and Vermont, 271,631 pounds; Southern States, 18,201; lead desilverizers, etc., 2,618,074; total domestic copper, 225,494,425; from imported pyrites and ores, 4,909,556; total (including copper from imported pyrites), 230,403,581. Of the total quantity of copper produced in the United States in 1888, about 158,000,000 pounds was refined in this country.

The Westinghouse Alternating Plant in the Hoosac Tunnel.

Probably few installations have been more difficult to carry out than that put in by the Westinghouse Electric Company at the great Hoosac Tunnel, for the Fitchburg Railroad Company, and illustrated on this page. The work, which began several months ago, has, however, been carried through with success, despite the many and serious obstacles in the way. The difficulty of pursuing this work, as a recent visitor remarked, may be imagined when it is understood that a torch sheds but a meagre, uncertain light through the Egyptian darkness, thick with smoke that incessantly prevails in the tunnel, while the workmen had to contend with the constantly dripping water from the roof and sides, the constant passing of trains, the sulphurous gases, and the prevailing damp that quickly rusted and corroded tools and metal parts of the works.

Through this tunnel, in the face of these obstacles, forty miles of lead-covered cable, made by the Standard Underground Cable Company, were laid in wooden conduits, in trenches on each side of the tracks, an undertaking requiring extreme care and watchfulness, for a slight defect or an imperfect joint might have rendered necessary the taking up of miles of cable. In fact, ordinary line wire, as well as some special insulations, proved a failure under the severe tests put upon them by the conditions obtaining in the tunnel. Owing to the excessive moisture, the absolutely perfect insulation of the wires for 8,000 feet of cable was rendered necessary. Power for the light is furnished from a small building near the west portal of the tunnel, where two 125 h. p. boilers, a 125 h. p. engine, three No. 1 Westinghouse alternating current dynamos, each of 650 16-c. p. light capacity, and two Westinghouse direct-current machines for exciting the larger dynamos, constitute the apparatus. One dynamo is reserved for use in case of emergency, if either of the others break down.

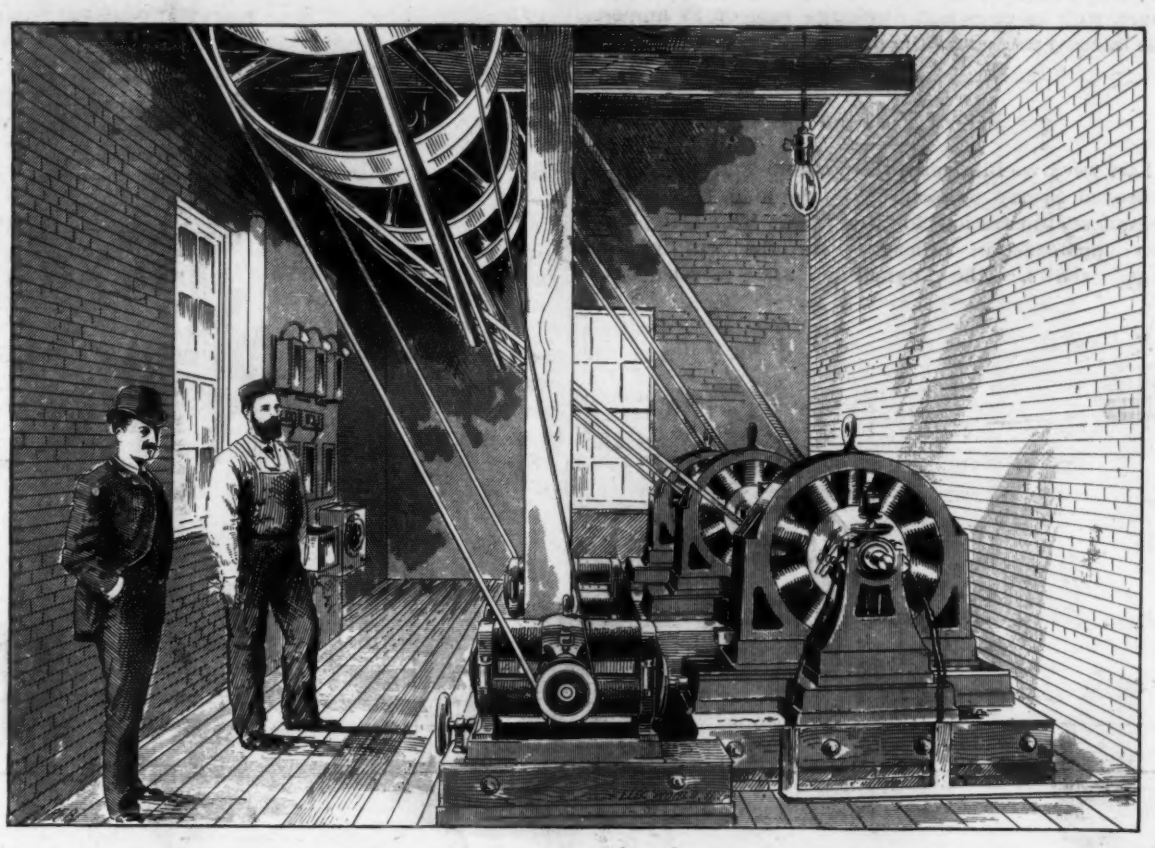


FIG 1.—DYNAMO ROOM, WESTINGHOUSE ALTERNATING PLANT, HOOSAC TUNNEL, MASS.

The lamps in the tunnel are arranged in sections of twenty 50-volt lamps each. In case of a break any section can be cut out without disturbing the rest of the system. Each lamp is provided with a cut-out, so that in case any lamp burns out, the rest of the lamps on the section will be kept burning.

The railroad company's objects were to afford the traveling public as great safety as possible, and to facilitate operations in the tunnel. With the tunnel all alight a greater amount of work can be accomplished by the workmen, and engineers can, on favorable days, in the absence of fog, see the track for nearly a mile ahead.

Fig. 1 is a view of the dynamo room. In Fig. 2 is a view of the station, together with sketches of both portals. The sketch 4 shows one of the lamps imbedded in a mass of ice, and 5 is an excellent glimpse of the tunnel with the long line of lights on each side.

It deserves mention that the success of the plant is largely due to Mr. Thomas Spencer, the chief electrician of the Marr Construction Company, of Pittsburgh, who took the contract from the Westinghouse Company. He was assisted by Mr. John H. Grier and Mr. Edward Davis, the latter having full charge of the work since September. We are under obligations to Mr. Davis for assistance in the preparation of our article.

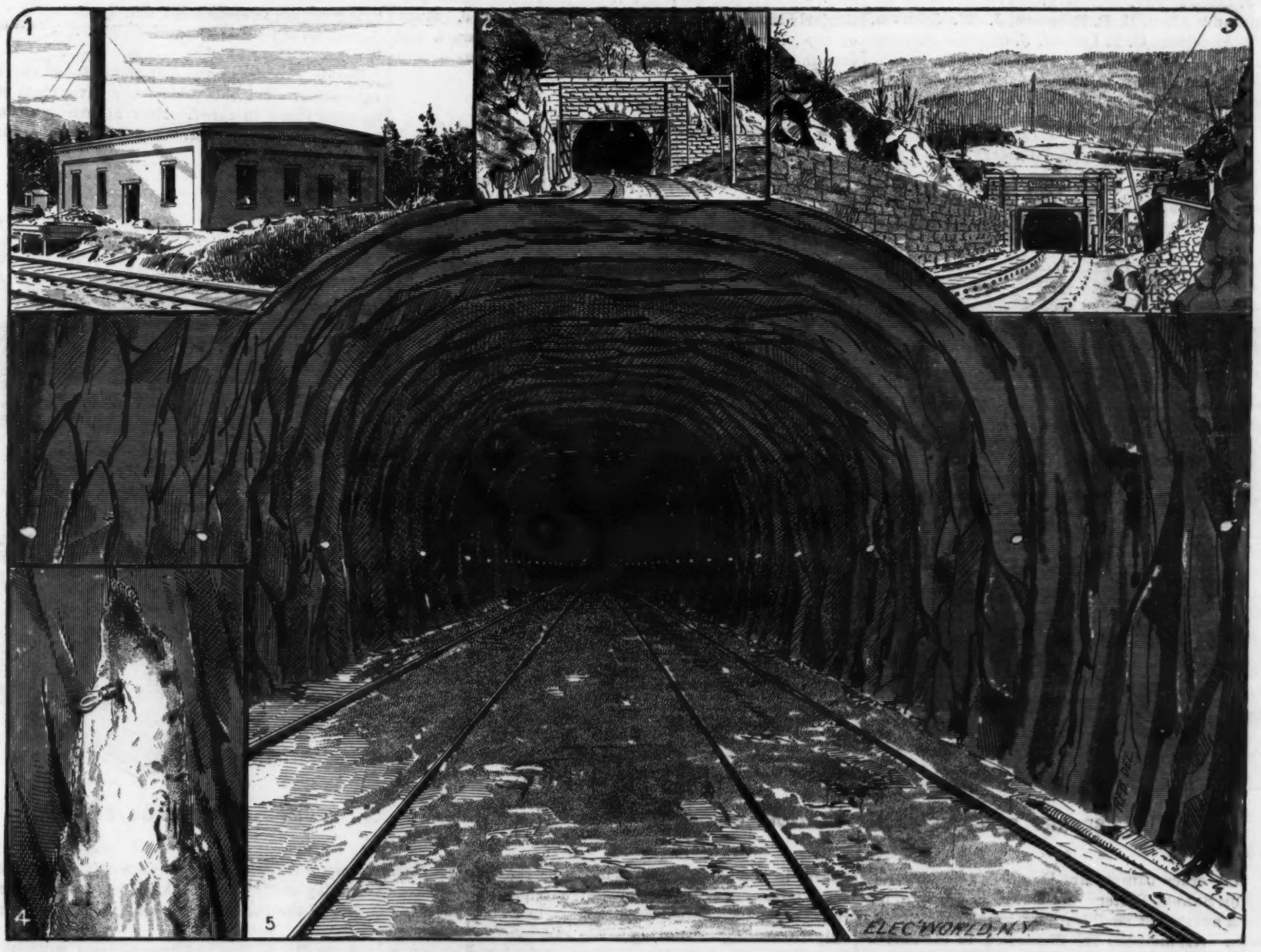


FIG. 2.—FEATURES OF THE ELECTRIC LIGHT INSTALLATION IN THE HOOSAC TUNNEL, MASS.

Lighting at Little Rock, Ark.

To the Editor of The Electrical World:

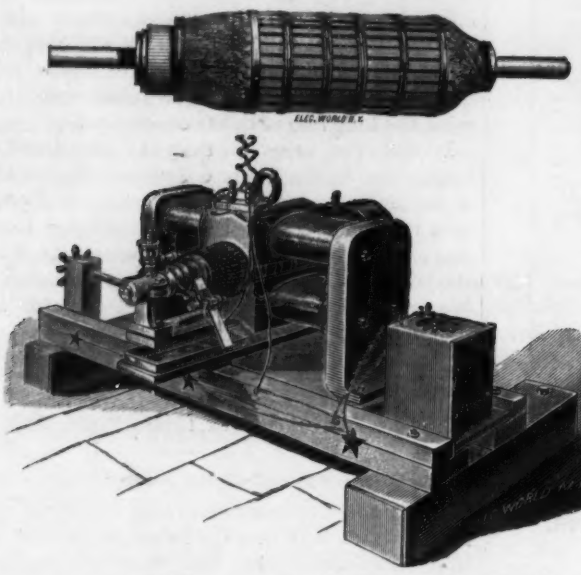
SIR: I notice a statement in THE ELECTRICAL WORLD of Feb. 9 which says that the Edison Company at this place have endeavored, without success, to consolidate with the Westinghouse Company here. I wish to state that the assertion is false. No such proposition was ever made by this company or ever will be. We are at present running one-third more lights than the Westinghouse Company, although starting a month later, and although our price is one-fourth higher than theirs, we have lost but two customers since starting, and those two the Westinghouse Company proposed to light up "free gratis" if they would take our lights out.

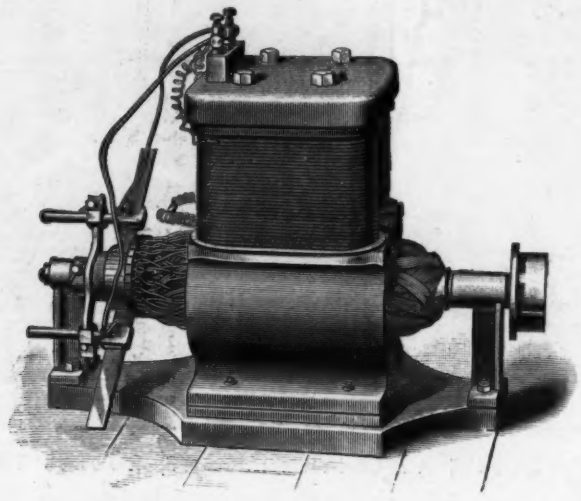
E. F. HORN,
Supt. Edison Light and Power Company.
LITTLE ROCK, Ark.

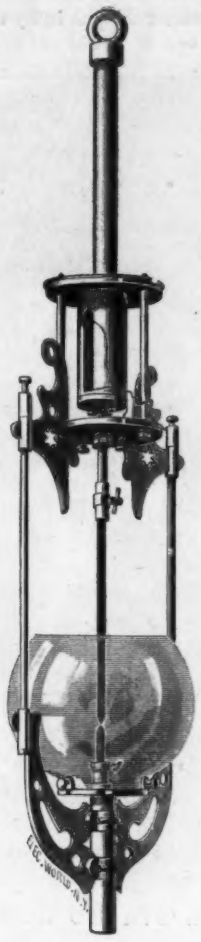
The Cohen System of Electric Lighting.

Our illustrations herewith represent the dynamos and other details of the system of electric light and power designed by Mr. Robert L. Cohen, electrician of the National Electric Light and Power Company, of Philadelphia. The engravings, Figs. 1 and 2, represent the arc dynamo and lamp designed by Mr. Cohen, and Figs. 3 and 4 show the incandescent machine with its armature. As will be seen, the latter is of the consequent pole type. In a 200-light machine, recently constructed, the armature core was built up of 340 soft iron plates. The armature revolves at a speed of 570 revolutions per minute and generates a constant E. M. F. of 120 volts, with varying loads.

The company has quarters in the Drexel building, Philadelphia, and at the regular meeting in January last elected these officers: Gen. W. S. Merrill, president; William T. Anderson, vice-president; Hon. George F. Leland, treasurer, and J. Clayton Erb, secretary. The directors are Messrs. Edmund Allen, H. E. Robinson, J. W. Johnson, William T. Anderson, G. F. Leland, J. Clayton Erb and Robert L. Cohen. Mr. Cohen was subsequently chosen electrician. The company is already actively at work, and has secured a number of contracts for plants.







FIGS. 1, 2, 3 AND 4.—THE COHEN (NATIONAL ELECTRIC COMPANY'S) SYSTEM OF ELECTRIC LIGHTING.

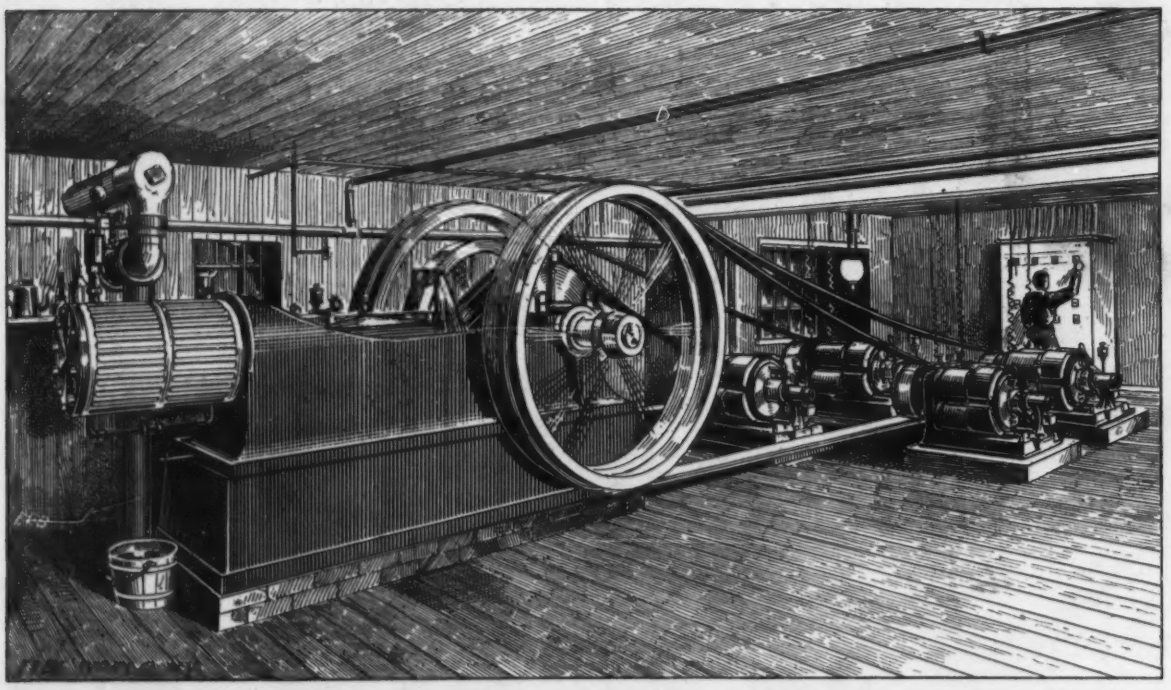
The Pumpelly Storage Battery.

In seeking to avoid the difficulties that have often been encountered in storage batteries during the past, due to the detachment of the active material from the plates, buckling, and other causes, Mr. Pumpelly, electrician of the Pumpelly Storage Battery Company, of Chicago, has introduced a number of modifications in the construction of such cells. His methods are illustrated in the accompanying engraving. As will be seen, the plates are arranged to lie horizontally. They are cast of a composite metal of the gridiron form, and so perforated as to hold the largest amount of minium in a secure manner. They are insulated by rings of pure rubber, and between each pair of plates there is placed a sheet of asbestos cloth. If by any chance or accident any peroxide falls, it is caught by the asbestos cloth and cannot cause a short circuit. At one end of each plate is a hub covered with rubber, into which the plate of the same kind above it fits snugly, and through all of them is threaded a copper conducting rod, which is coated with lead to protect it from the acid.

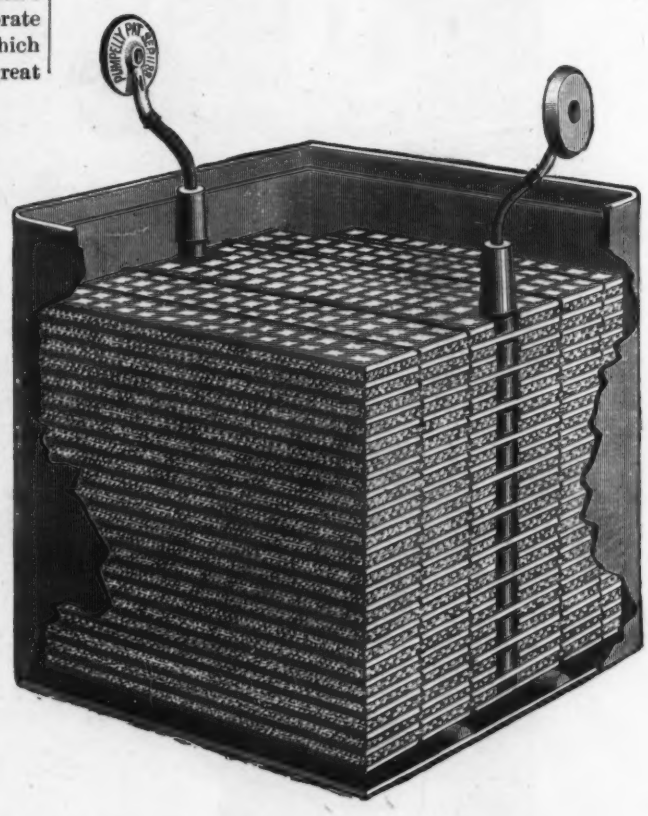
The standard cell illustrated is composed of 11 positive and 12 negative plates, each 6¼ and 6½ inches, placed in a vulcanite case, 8 × 8 × 10 inches. The whole weighs but 32 pounds, and has a working capacity of 240 ampère hours, with an economic discharge rate of 25 ampères. The internal resistance in discharge is .003 ohm.

A Sperry Plant in Chicago.

Last week we illustrated the dynamo and lamps of the improved Sperry system. We are able this week to present an illustration of the Sperry station employing this apparatus in Chicago. As the cut on this page shows, the dynamos are driven by a New York Safety steam engine. The plant is very neat and compact, and the boiler room arrangements are particularly ingenious as well as economical of space. Many of the electric light visitors to Chicago this week will take the opportunity to inspect the station and apparatus for themselves.



SPERRY ELECTRIC LIGHT STATION. CHICAGO.



PUMPELLY STORAGE BATTERY.

A Pleasant Episode at the Edison Laboratory.

For a month past the persons employed at Mr. Edison's laboratory at Orange, N. J., were preparing for an elaborate recognition of the inventor's forty-second birthday, which occurred on Feb. 11. When Mr. Edison entered the great library in the laboratory that morning the two or three small tables, as many odd chairs, a triplet of well-worn rugs and a dismantled clock, which had constituted the only furnishing of the big room outside the well-filled book-shelves, had disappeared, and instead was an array of luxurious furniture which would break the resolutions of a mediæval ascetic. Seven heavy, carved oak tables, a score and a half of handsome leather-covered oak chairs, each bearing a carved monogram of "T. A. E.," a big gas log burning brightly upon a pair of fantastic wrought-iron andirons, and the old clock face, with new hands and regulated by wire direct from Washington, were the principal changes. That which claimed Mr. Edison's attention most was a full-sized phonograph of gold, silver and steel, provided with the new automatic regulator for adjusting the pressure of the stylus upon the wax cylinder.

"It is," said the inventor, "the first complete phonograph ever made. For three months I have been at work on that regulator, and I completed it on Saturday. The bothering old thumbscrews will be done away with, and there will be no more trouble about fixing the stylus at the proper elevation."

Beside the desk was a deep-cushioned and adjustable easy chair. On the table was a silver cigar case with a hunting scene in relief. Near at hand was an engraved card bearing the legend: "The surrounding outfit of laboratory conveniences are presented on his forty-second birthday to Mr. Thomas A. Edison by all the present and a few of the past workers in his laboratory, Orange, Feb. 11."

After Mr. Edison had been allowed to inspect the new things in private, the committee of the employés, Messrs. Kennelly, Tate, Wangemann, Hammer and Ott, presented their congratulations. The enterprise of the men who had fashioned the silver automatic regulator since Saturday was a marvel even to the inventor. Most of the furniture had been stored in the building Friday, but he knew nothing of its presense till he saw the entire two-thousand-dollar outfit in place Monday. He sent at once for a caterer, and luncheon was served for the 130 persons in the laboratory.

The Burning Out of Armatures.

BY H. FRANKLIN WATTS.

The burning out of armatures is one of the most unfortunate occurrences that befall our central stations, and is indeed all the more trying from the fact that it usually occurs at the most important hour, and when the services of the special machine are most earnestly desired.

The burning out of armatures is not unfrequent in some systems, and is attributed to many causes; and we hear much of the advantages of ring over drum armatures, and the necessity of isolating those coils having a great difference of potential; but to the mind of the writer the cause is of an entirely different nature, and becomes as much of a mechanical as an electrical problem, which will receive due treatment in the course of this paper.

When the armatures are first wound the insulation is very high up in the megohms, or beyond the capacity of ordinary instruments. We would naturally think they would never burn out. They run a year, perhaps two or three, and then without warning, suddenly burn out, and the true cause—the root of the evil before it has resulted in actual burn—is forever concealed from view in a mass of charred coils, wire and burned insulation. That the insulation deteriorates by use is obvious, but as to the exact cause and remedy there appears to be some question. Let us look at this thing from a mechanical standpoint.

It is claimed by many that the power absorbed by a dynamo is expended in driving the *armature coils*, that the armature coils are entirely free from magnetic drag, and that the band wire is merely to prevent the coils from flying off under the influence of mechanical forces, tangential inertia, etc. Experience has, however, repeatedly demonstrated that it is precisely the reverse, and that the power applied to the pulley is spent in driving the *armature coils*, and that the armature coil absorbs no power in itself beyond that negligible amount due to the generation of currents within its own mass, and which are very aptly called "eddy currents." How is it then in the majority of the lighting systems?

The armature coils which require power to drive them through the field are wound upon a perfectly smooth core, and depend upon the binding wires for their driving power, while the armature core, which absorbs no power in itself, is securely keyed to the shaft.

The keying of the armature core to the shaft has, however, an important function to perform, since the armature core is in all cases the medium through which the driving power is transmitted to the coils. The tremendous rush of current due to an accidential short circuit upon an incandescent dynamo frequently stalls a large engine, stopping it in its tracks; and when we consider that this manifestation of power is upon the *armature coils*, we involuntarily ask ourselves why were they not torn off bodily by the magnetic pull? Is it then a wonder that there are so many burn-outs? Is it *not* a wonder that there are not more, and that every short circuit does not mean a first-class burn-out?

The fuses employed in the incandescent systems, especially those using high potentials, afford very little protection from such momentary currents; they must necessarily act like the old farmer, who immediately locks his stable after the mare has been stolen. Alternating currents, however, offer other and absolute means for protection.

An excellent feature of the Brush machine is that its armature coils are driven in a positive, mechanical manner. They can neither get up nor down, forward or backward, and there is no tendency for them to move sidewise. They are bound to be driven through the field, as two large shoulders, each 2 × 5 inches, are presented square to each coil. What motion there is occurs between the coils *as a whole* and the insulation of the core, which is ¼ inch thick and *not* the different convolutions of wire, one upon the other. It is this latter action that is the deteriorating influence in most dynamos. The armature coils, subjected to a continual shake and jar, and held in place by the band wires only, work upon the core and against each other, and it is only a question of time when the insulation of two adjacent wires is worn through, the bare wires come in contact, the current in the short-circuited portion increases enormously, and all is over in a moment. A burn-out then happens which was "without apparent cause."

Furthermore, in some systems, especially those in which the induction per foot of armature conductor is very high, heavy currents are generated in the band wires upon the armature.

These currents, it is true, are of very low electromotive

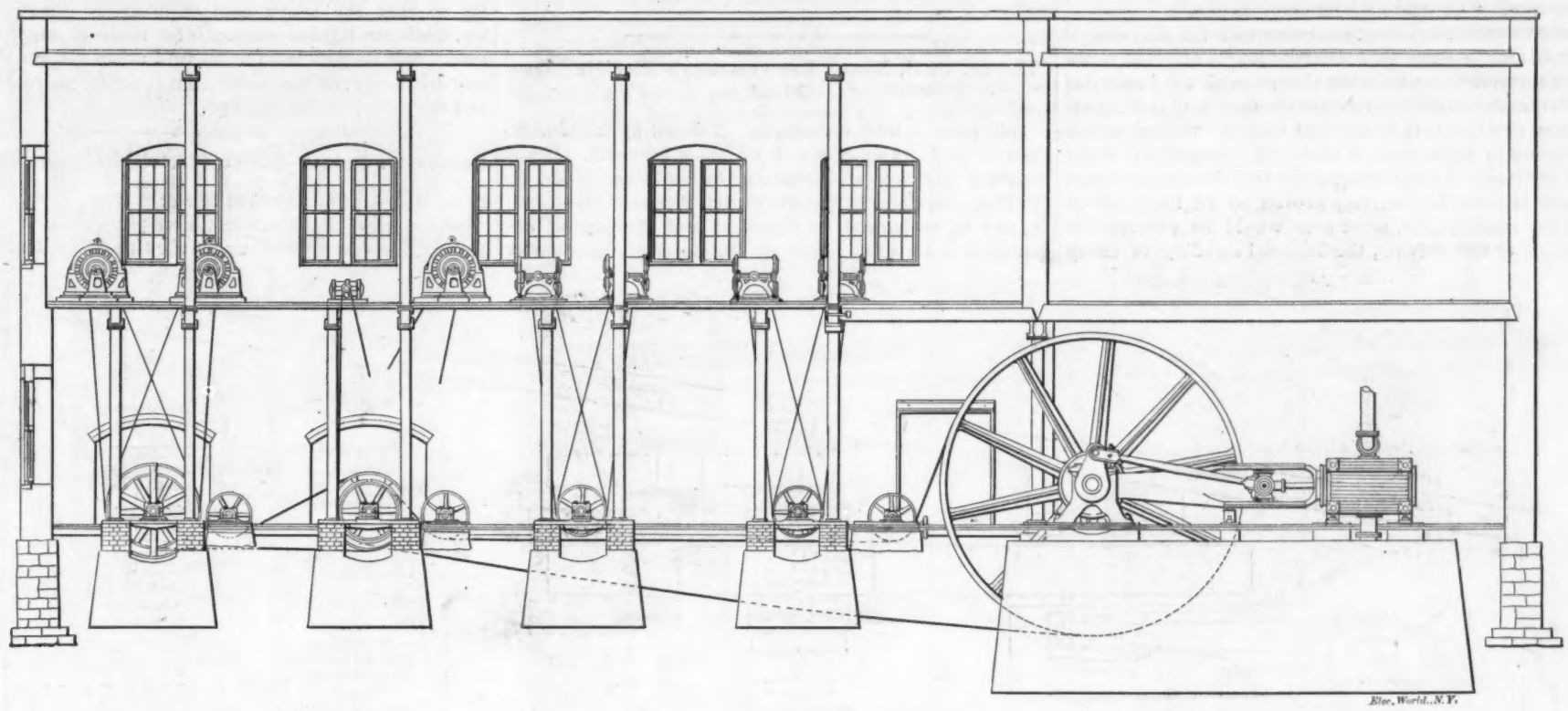


FIG. 1.—HILL CLUTCH EQUIPMENT, ST. PAUL, MINN. NEW ELECTRIC LIGHT STATION. (See Page 100).

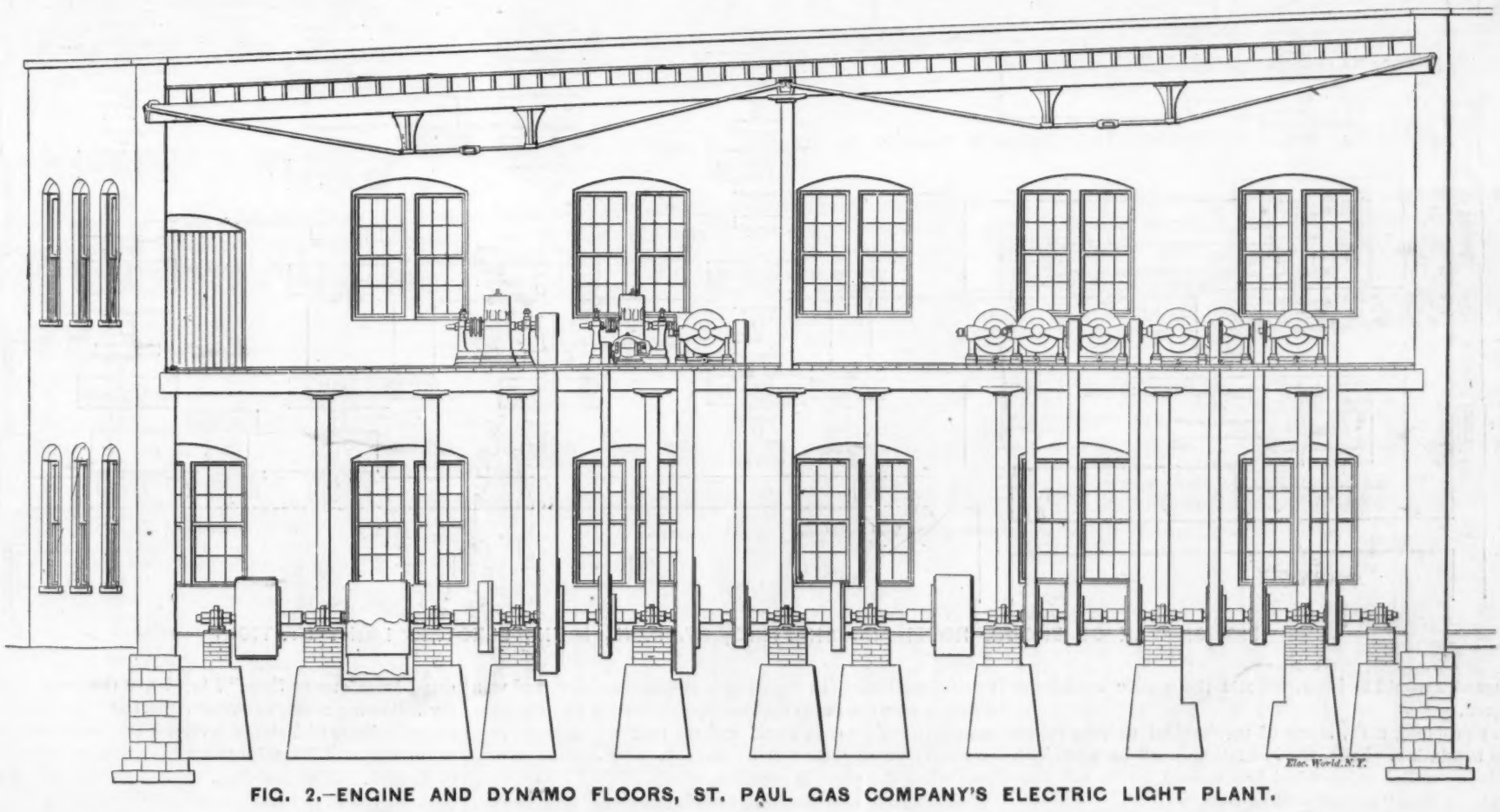


FIG. 2.—ENGINE AND DYNAMO FLOORS, ST. PAUL GAS COMPANY'S ELECTRIC LIGHT PLANT.

force, due to the short length of the band wire parallel with the copper conductor, but the surface of the band wire undergoing induction is large and the currents are of great volume, and as a natural result the band wire is the first to get hot. It therefore expands and loosens its hold upon the coils, and thus exaggerates the action described.

The Brush is probably the only representative of a machine in which the armature coils are correctly mounted and driven. "Credit to whom credit is due."

Unfortunately, however, the many calls for the renewal of armatures becomes an important source of profit to the manufacturers apart from the chagrin which is justly due (but which is too seldom felt) for the destruction of its apparatus, and it is safe to say that were the various parent companies by legislation, or otherwise, compelled to make good the losses of local companies, the burning of whose armatures could be positively proven to be the result of defective construction, more care would be exercised in the winding and driving, the financial standing of many companies would be improved and the public confidence insured.

The problem, then, is one of mechanical driving rather than insulation. True, the insulation must be sufficient, but being sufficient, as when first wound, let it not deteriorate by use, "and all will be well."

ISOLATION IS THE BEST INSULATION.

The construction of the large machines for the Grosvenor Gallery installation, as described in THE ELECTRICAL WORLD of Dec. 1 and 8, 1888, contains one feature worthy of more than a passing notice. The armature coils are held in place by a compound of sulphur, which unites them to the driving frames in a mass as solid as iron, and which is in itself an insulator. This would appear to be an unique feature. The subject of the proper driving of armatures is of the greatest importance. Let us see what will be done.

A Statue to Ohm.

A meeting was held recently in the Royal Society's meeting room, London, to appoint a committee, with a view of obtaining subscriptions in aid of a proposed memorial to Ohm. The 16th of next March will be the hundreth anniversary of the birth of George Simon Ohm, and in view of the near approach of the centenary of the birth of a man who has done so much for electricity, a committee has been formed in Germany to promote the erection of a statue of Ohm in Munich, the capital of his native State, Bavaria, and the city in which the latter part of his life was spent as professor of physics in the university. The co-operation of those who in other countries take an interest in this design of honoring the memory of a benefactor of his race has been invited by the German committee.

The St. Paul, Minn., Gas Company's Electric Light Plant.

This plant is well represented in detail by the illustrations, Figs. 1, 2 and 3, which we show herewith. It was designed throughout, including the building, by Mr. H. W. Hill, proprietor of the Hill Clutch Works of Cleveland, O., and is recognized by electrical and mechanical engineers as a very fine piece of engineering, and a model central station. The building is two stories high, and was made to suit the capacity and requirements of the business both for present work and for future increase. It is so solidly put together that there is no vibration in any part when the plant is running.

The engine and shafting foundations are very heavy, the latter being of brick and iron and proportionately as solid as the engine masonry work. Experience, the Hill Clutch Works say, has taught them that nothing should be used for shafting foundations but brick and iron, wood being entirely out of the question.

The engines are of the Corliss pattern, with a capacity of 2,500 h. p. There are four lines of shafting, fitted up complete with the "Hill" friction clutch pulleys and couplings. Main belts are so arranged as to run under the floor and interfere in no way with the line shafting or passages. We may mention here that the Chas. Munson Belting Company, of Chicago, who have a wide reputation, belted up this station.

The plan shows shafting bolted to the foundations and kept in line by special adjustable ball and socket boxes. These boxes are of extra length and designed for electric light work, and are made interchangeable. Lubrication is performed by an automatic oiling system. All the parts of the clutches are also made interchangeable.

The amount of powor lost through friction in driving the four lines of shafting, etc., is less than 10 per cent., and considering the economy of Corliss engines, this plant is a most economical one.

The dynamos (Thomson-Houston) are on the second floor and are entirely independent of the line shafting. They are driven by friction clutch pulleys, which are fitted with vertical shifter rigs that can be handled from either floor. The dynamo belts run upward and hang on the dynamo pulley, so that the heavy contact is on the smaller pulley, while the lightest contact is on those of large diameter. This permits belts to be run much slacker than in any other way, at the same time insuring perfect safety and the least possible slippage.

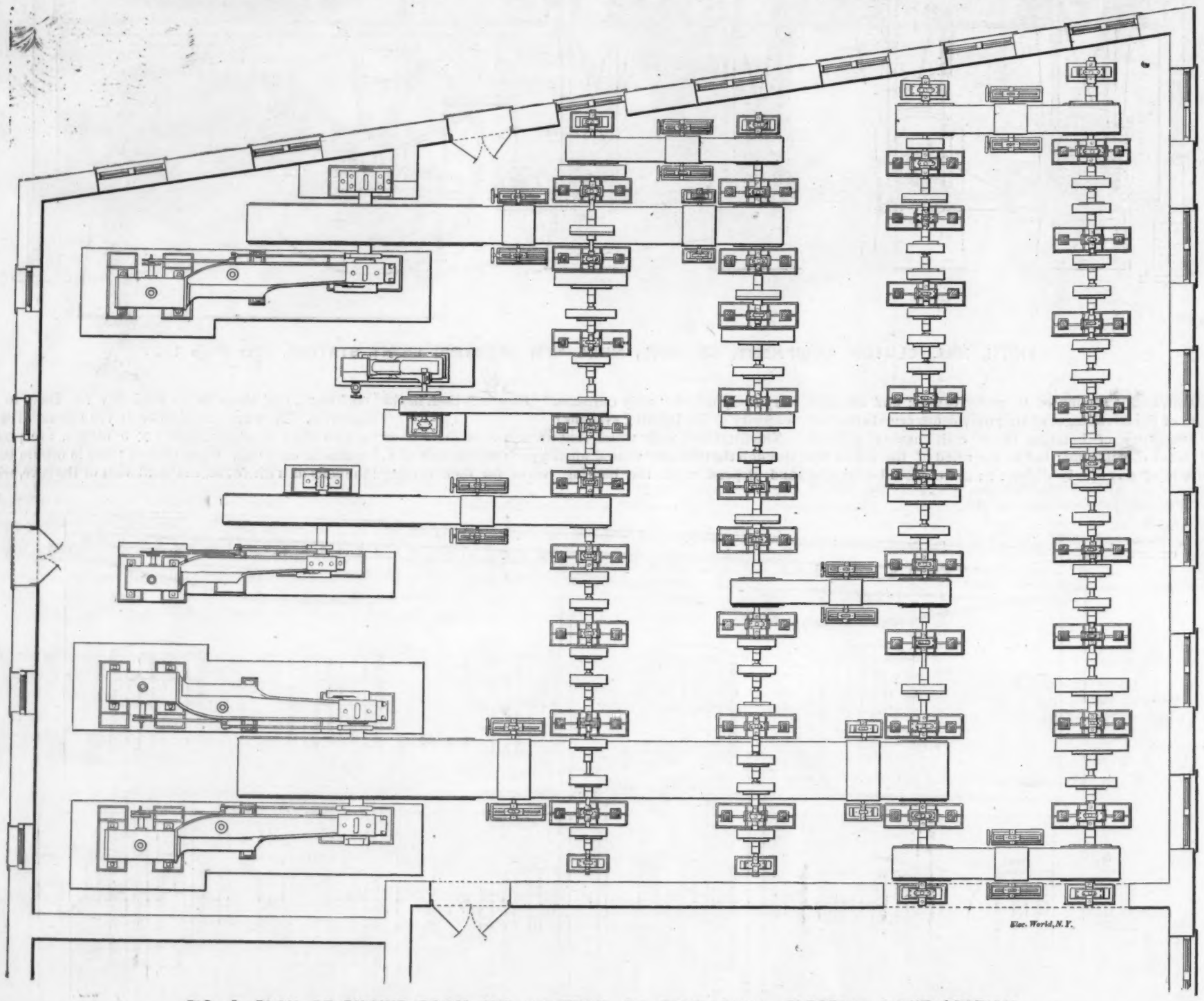


FIG. 3.—PLAN OF ENGINE ROOM AND SHAFTING, ST. PAUL, MINN., ELECTRIC LIGHT STATION.

Hunter vs. Knight—As To Electric Railway Patents.

To the Editor of The Electrical World:

SIR: In view of the publication in your paper of Feb. 9, of the "Business Notice," under the title of "A Hotly Contested Interference Case," I beg leave that you will print my following remarks relative thereto. It is true that the Commissioner of Patents reversed the equitable decision of the Board of Examiners-in-chief and awarded priority to Knight. In so deciding, the Commissioner turned his back on the U. S. Statutes and gave a decision which was totally at variance with the law upon the question of "priority of invention." His decision amounts to saying that the man with the most money, and the ready use of that money to put the invention into operation is the man to have the patent, notwithstanding, as in this case, the contestant proved his invention to have been *completed* almost *two years prior to the conception* of the successful contestant. His decision also amounts to saying that no invention is made until an actual machine or structure is built, for he admitted that my invention was clearly proved in January, 1883, whereas Knight did not conceive of the invention until August, 1884, on one issue, and November, 1884, on the other. I had a complete working model in October, 1883, showing the invention clearly, and filed my application seven months after Knight's conception and reduction to use, and three months after he filed his application. Notwithstanding all the diligence and untiring efforts and perfect showing of a completion of the invention, and its embodiment in

a model from one to two years before Knight's conception, he decided that my efforts and proofs would not avail me, because they had not at the closing of my testimony resulted in an actual practical use of the invention. This decision was adhered to, even when it was proved, on motion for re-hearing, that I *had* practically used the invention on a full-sized railway immediately after the closing of my proofs. The decision is so unjust and contrary to all equity practice, as well as the statutes themselves, that I will say the decision cannot rest.

A suit in equity is now being prepared to have Knight's patent annulled and the Commissioner compelled to issue a patent to me. This case may be taken to the Supreme Court, and will, no doubt, settle the question as to what is "a first and original inventor," and whether a "second" inventor shall be allowed under any conditions to grasp from the rightful possession of the "first" inventor his invention simply because he has more money with which to put the invention into use. This case will also decide whether the statutes on the granting of a patent to the first and original inventor calls for any reduction to practice beyond a proof of his invention, such as would be evinced by an application for a patent. It will show that diligence has no place in an interference proceeding, and that abandonment is the only question which can arise, for if the original inventor cannot have the patent, the invention goes to the public, and not to the second inventor. It is significant to note that the examiners-in-chief, who have been in office over 20 years, decided so positively in my favor, and that the Commissioner who has only had an extremely small training in patent law should have reversed it. I will license any one desiring to use the invention in controversy and will guarantee to protect him in the courts. This shows what I think of the Commissioner's decision and the patent which Knight may obtain under it.

R. M. HUNTER, M. E.

PHILADELPHIA, Pa., Feb. 9, 1889.

FIG. 1.—EXTERIOR OF EDISON STATION, CHICAGO.

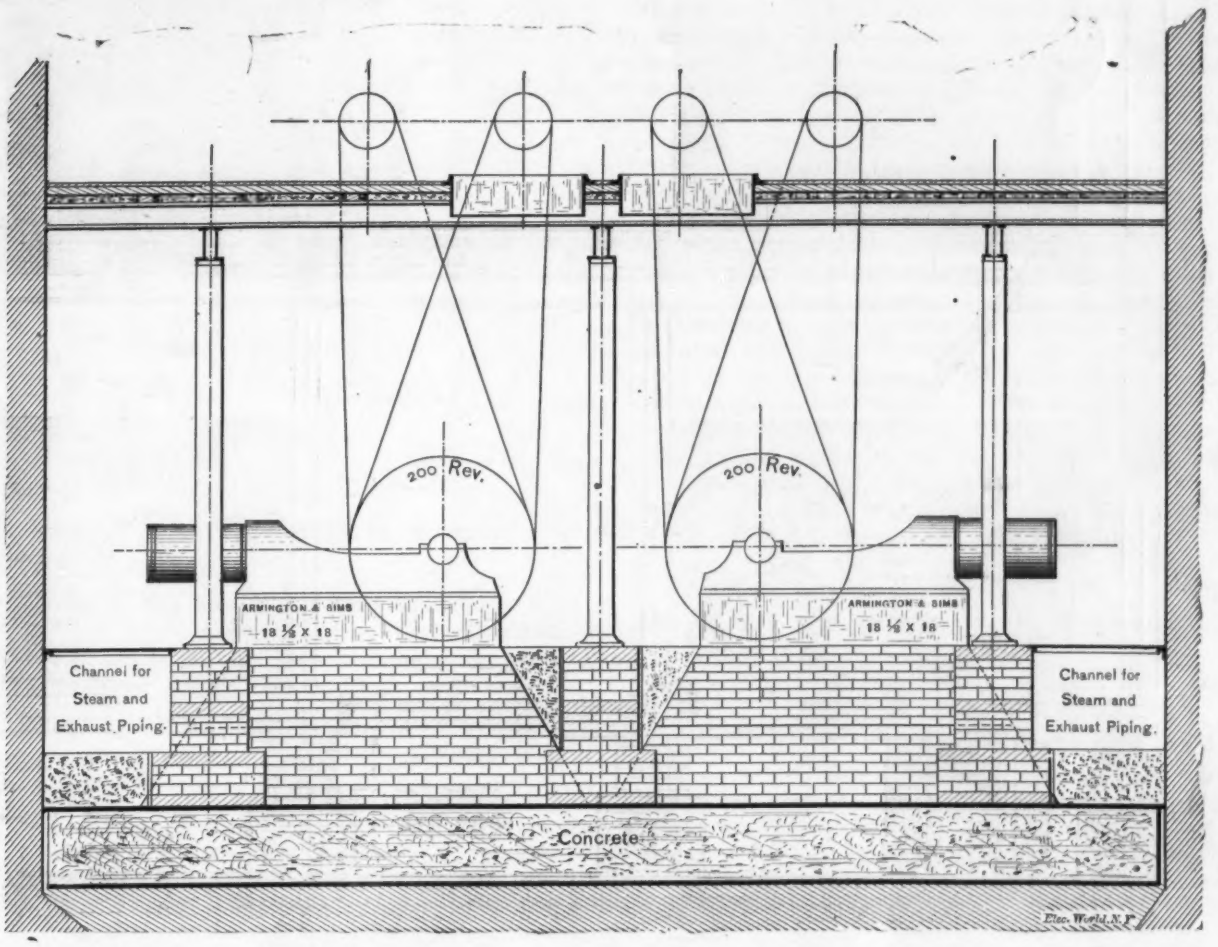


FIG. 2.—DETAILS OF ENGINE FOUNDATIONS, EDISON STATION, CHICAGO.

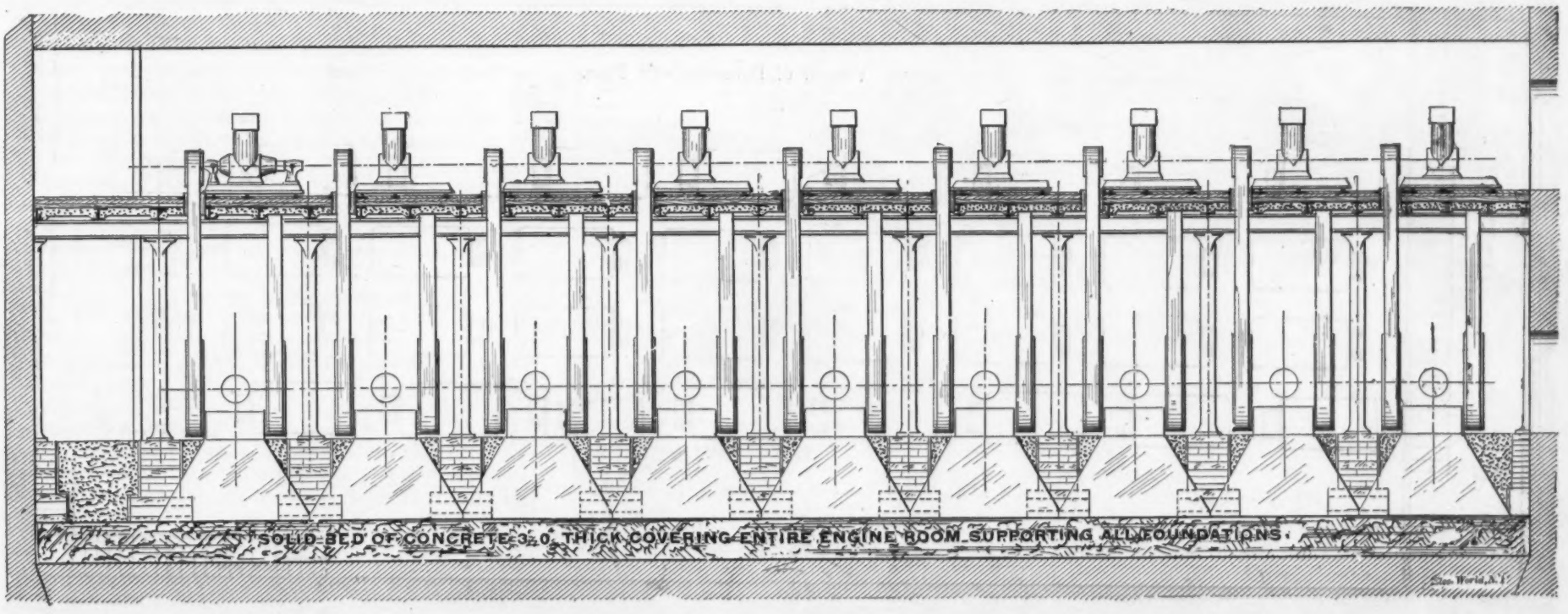


FIG. 3—FOUNDATIONS, ENGINE ROOM, AND DYNAMO ROOM, EDISON STATION, CHICAGO.

Disputes as to Candle Power.—The cities of Springfield and Northampton, Mass., are both disputing their electric light bills on the ground of short candle power.

The Edison Central Station at Chicago.

The success achieved by numerous Edison illuminating companies, during the past five years, as illustrated in cities and towns of moderate size, and evidenced in our recent article on the new Edison stations in New York, has naturally drawn the attention of capitalists to incandescent lighting on such a basis as a profitable field of investment for the largest cities, such as New York, Chicago, Philadelphia, Boston, Minneapolis, Kansas City and others. In fact, the only inference to be drawn from the results given by the smaller stations, is that on a larger scale of operation the return would be found greater than was the case where the plant was small, and the output comparatively limited.

Early in the year 1887, the Chicago Edison Company was organized with the following gentlemen as officers: President, Anthony F. Seeberger; vice-president, Robert T. Lincoln; secretary and treasurer, F. S. Gorton; directors, the above with Messrs. Doane and Lauderback. After the organization had been effected, considerable time was spent in carefully determining upon the district in which the Edison light should be first supplied, and the location within that district of the central station. The main boundaries of the district are as follows: Harrison street Market street, Water street and Michigan avenue.

A canvass of the lighting to be supplied in this important territory showed a business of at least 150,000 burning

lights. The location of the station has been selected with regard to its fitness and adaption to the various needs of future business, and also with respect to its position near the electrical centre of the district. The station is located on Adams street between Clark and La Salle. The size of the lot is 45 feet front by 190 feet in depth. The designing and engineering work of the station was wisely entrusted to the Engineering Department of the Edison Electric Light Company, of which Mr. J. H. Vail is general superintendent, where all of the electrical engineering and steam engineering features were fully formulated, and plans carefully prepared. A set of these plans, showing the position of all the boilers, engines, dynamos, etc., for the present and future equipment of the station, was placed in the hands of Mr. S. S. Beman, one of the most prominent architects of Chicago. The good sense of the Chicago Edison Company in selecting Mr. Beman as their architect has been well proven by the character of the building which he has designed and constructed for their purposes. The building, Fig. 1, covers the entire lot and is of the most substantial fire-proof construction, costing about $125,000. In order to fit it for the peculiar character of the industry to be carried on, many new features of construction, Figs. 2 and 3, were found to be necessary. These are seen in the foundations, iron work and various other details. As now constructed, the main building is a basement and one story in height. The section fronting Adams street is finished off two stories in height, with the intention of carrying it up some four stories additional in the near future. The arrangement of the building is as follows: In the basement at the front end are located the general store-room and workshop of the company. Through the centre is the engine room. In the rear end of the basement are coal vaults and ash vaults. Above this is a large boiler room, Fig. 4. On the first floor in the front of the building are located the general offices of the company. Above the offices are found the meter department and the electrical laboratory. Through the centre section of the first floor is located a large dynamo room, Fig. 5, and in the rear of the same floor is another large boiler room. The building is constructed of iron and brick throughout, and is considered one of the best fire-proof structures in the city of Chicago.

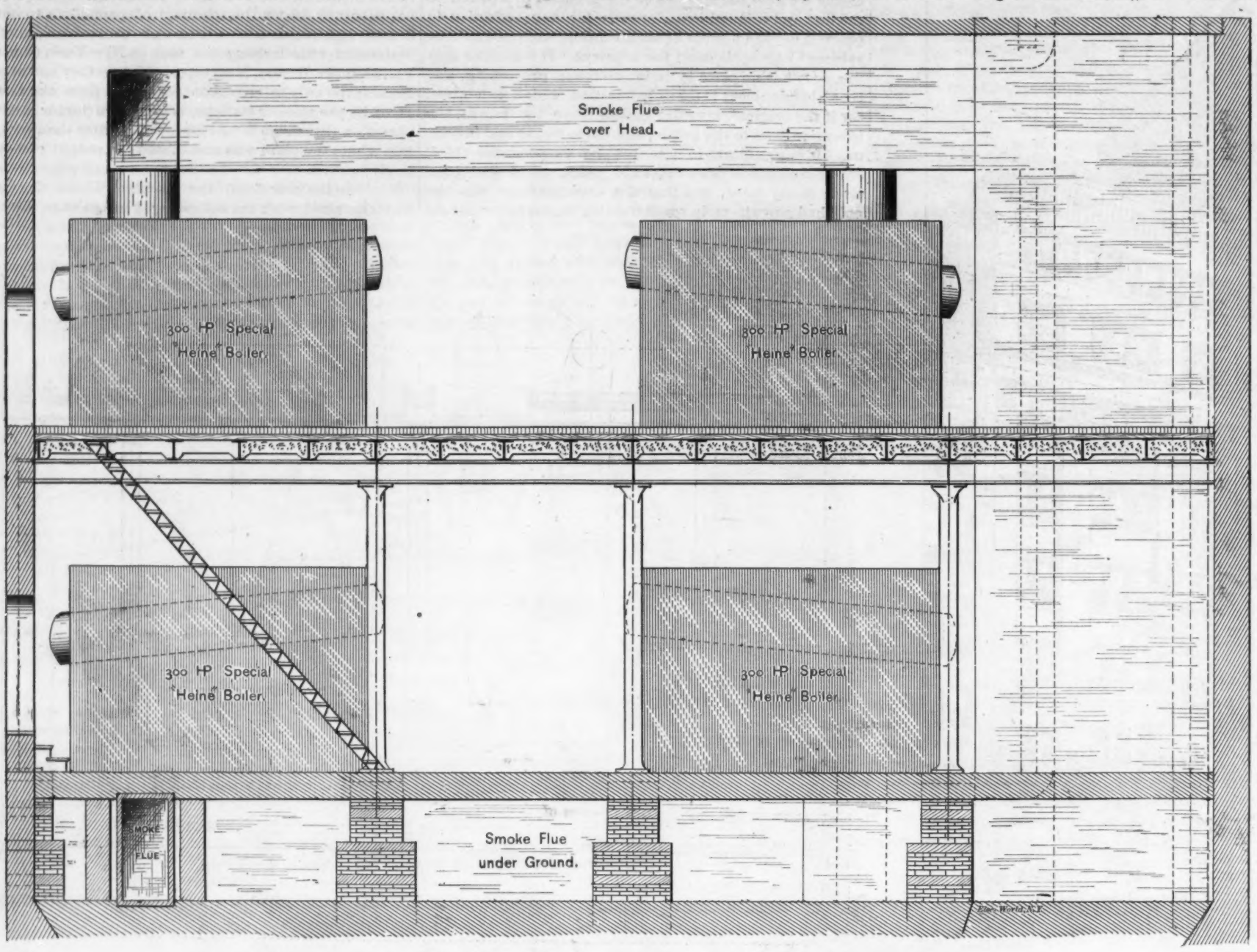


FIG. 4.—DETAILS OF BOILER ROOM, EDISON STATION, CHICAGO.

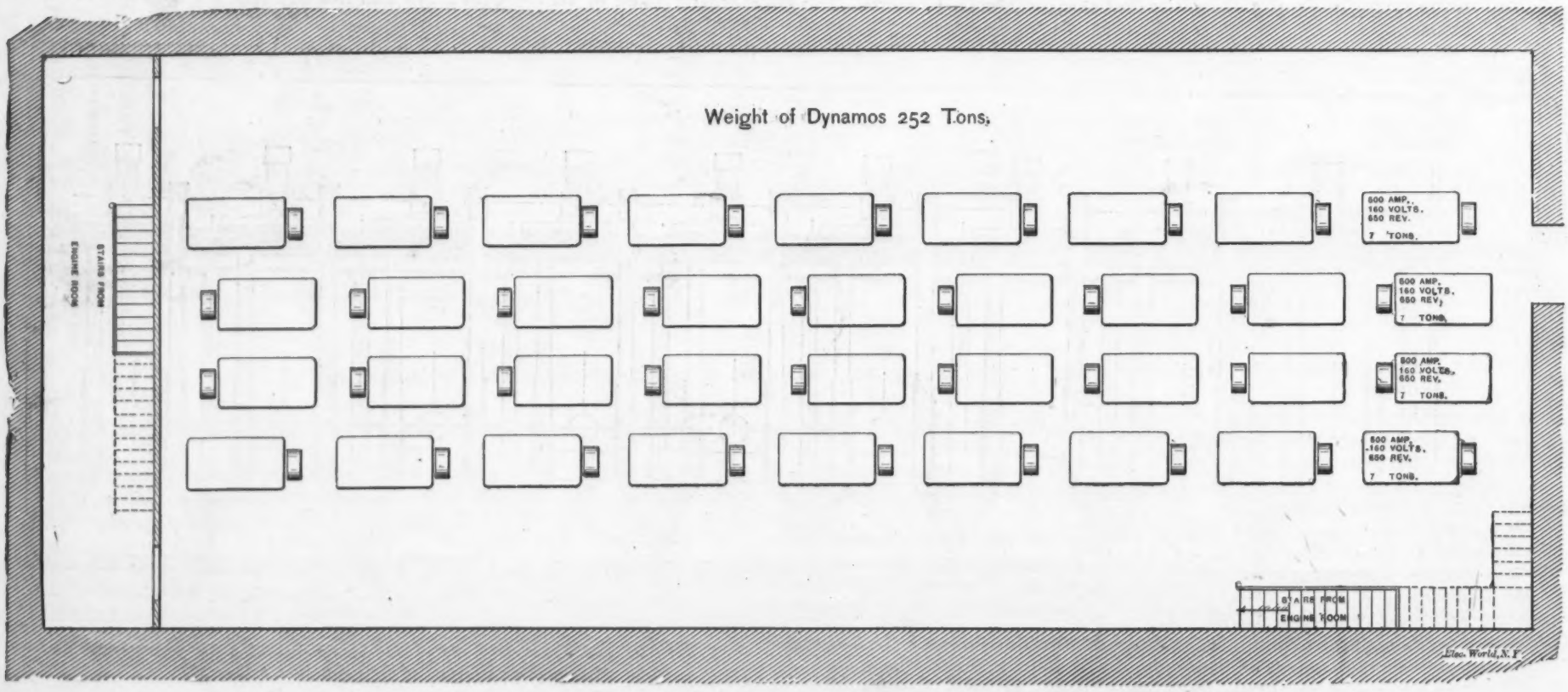
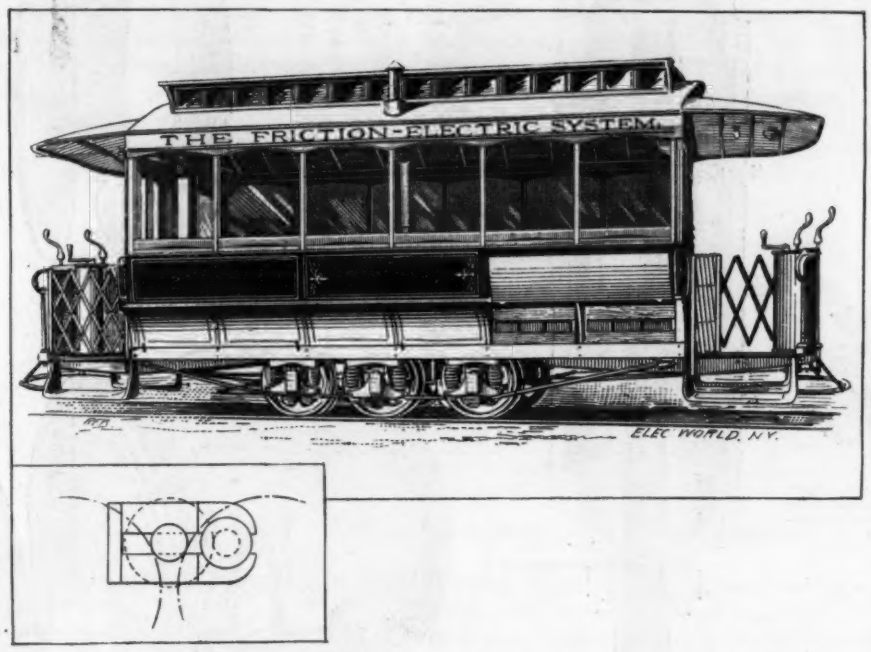


FIG. 5.—PLAN OF DYNAMO FLOOR, EDISON STATION, CHICAGO.

The engine room, located in the centre section of the basement, furnishes space for 18 engines of 200 h. p. capacity each. Four of the 200 h. p. engines are now set up and in use, and were specially built by the well-known

Armington & Sims Engine Company, of Providence, R. I. The size of the cylinder is 18½ inches by 18 inches in diameter, with 18-inch stroke. The speed is 200 revolutions per minute. Each engine is provided with two large driving wheels, 86 inches in diameter by 16 inches face. In the engine room are also located two large Worthington pumps, adapted to feed water to the boilers, and also for fire purposes should occasion demand. In the rear of the building are two large smoke-stacks of sufficient capacity to furnish ample draft to the furnaces. In the rear section of the basement are found two fine batteries of Heine safety boilers, aggregating 1,200 h. p. There is additional space in this boiler-room for 600 h. p. more of boiler capacity. The ash-pits of the boilers are so arranged that the ashes are delivered in the sub-basement below the boiler-room, and are then automatically carried from the building and dumped into ash carts for removal. The fire-room is of ample area, convenient, and is thoroughly well ventilated.



CAR OF "THE FRICTION-ELECTRIC SYSTEM" RUNNING IN BROOKLYN, N. Y.

The dynamo room, as already stated, occupies the central section of the floor, and gives space for thirty-six Edison dynamos, of the No. 32 type. Each dynamo has a capacity of 600 ampères. Eight of these dynamos have been installed, and are now in operation. The equipment of the electrical apparatus is very thorough and complete in detail. All the apparatus for the regulation and indication of current, as generated by the dynamos, is located on one side of the dynamo room. All the apparatus for controlling the manufactured current, such as feeder-equalizers, potential meters, ampère meters, feeder switches, and other devices for indicating and controlling the current delivered to the underground system, are located on the other side of the room, effectively and conveniently arranged.

The capacity named in boilers, engines and dynamos is nominal rated capacity, but this station has a margin or reserve of at least twenty-five per cent. in all apparatus, the same as the other large stations of the Edison system. This gives a comfortable feeling of confidence and ability to meet emergencies and sudden demands for current.

The power of the engines is applied to the dynamos by means of endless double leather belts.

The Edison system of underground conductors for distributing current on the three-wire method has been laid in many streets and avenues, and comprises at present seventeen miles of electric tubing, equaling fifty-one miles of copper conductors. This system has a capacity for supplying current to 80,000 16 c. p. lamps. The system has been so arranged that additional sections can be laid in cross streets not yet supplied, and thus eventually be joined up and form a part of the main system, thereby increasing the capacity from time to time in a scientific and economical way as the demands of the business prove to be necessary. These conductors are laid on each side of the street, and in some instances in the alleys running through the centres of the blocks.

At the present time the station is supplying current to a large number of customers, new ones being added every day, as fast as it is possible to get the wiring of each building properly tested and service connections made. There are now over 13,000 lights connected on to the system. A large amount of current is also disposed of for motive power purposes with excellent success, the power being applied to all the various uses, such as printing presses, elevator work, pumping, light manufacturing and a large number of miscellaneous industries.

The following may be mentioned as some of the principal customers of the company: Grand Opera House, 1,000 lamps; Grand Pacific Hotel, 750 lamps; C. F. Gunther, 250 lamps; Chicago Club, 350 lamps; National Union Building, 200 lamps; Phelps, Dodge & Co., 600 lamps; First National Bank, 200 lamps; Tacoma Building, 2,000 lamps.

The current is supplied to the consumers and charged for on the meter basis, the well known Edison electrolytic meter being used. The load diagram of this station often shows a maximum as high as 3,000 ampères, and a minimum as low as 150 ampères, thus fully demonstrating the advantages of the Edison meter system, as well as the flexibility of the station equipment.

The supervision of the mechanical work connected with the erection of the boilers, piping, engines, dynamos and general equipment of the station has been under the charge of Mr. F. D. Sargent, the superintendent of the Chicago Edison Company. The electrical equipment of the station was done under the supervision of the well known electrical engineer, Mr. W. S. Andrews.

The Friction-Electric System of Street Cars.

The new car of the Friction-Electric Company, of this city, now on trial at the Greenwood car stables, South Brooklyn, embodies several novel features of interest to electricians. The general idea of the designer, Mr. A. A. Ingraham, is that the man who controls the operation of the car need not be an electrician, and need only do the same work that the ordinary car driver does. The car, which is illustrated in the engraving, Fig. 1, is carried by a specially constructed framework, in which, instead of the ordinary two axles, are mounted three axles, two of which are movable with regard to the framework carrying them. The arrangement is shown in the sketch, Fig. 2. These two pairs of wheels are controlled by an ordinary brake lever at the front of the car, and the box in which the axles of these wheels are mounted has a limited movement with regard to the framework of the car. Their movement is controlled by a double bell-crank lever operated by the brake lever, and by which the pressure between the friction wheel and the car wheels can be increased or diminished at will. At present wrought iron against cast iron is used as a friction surface, but the intention is to make cast iron and cast iron operate against each other. The two front wheels of the car frame have on their surfaces annular cast iron rings against which the friction wheel works. Between these movable wheels is mounted a friction wheel, Fig. 2, carried by a counter shaft run by the motor. On this counter shaft is a gear wheel having wooden teeth mounted in a cast iron frame and meshing with a brass pinion mounted on the shaft of the motor. The motor and its frame are entirely independent of the framework of the car.

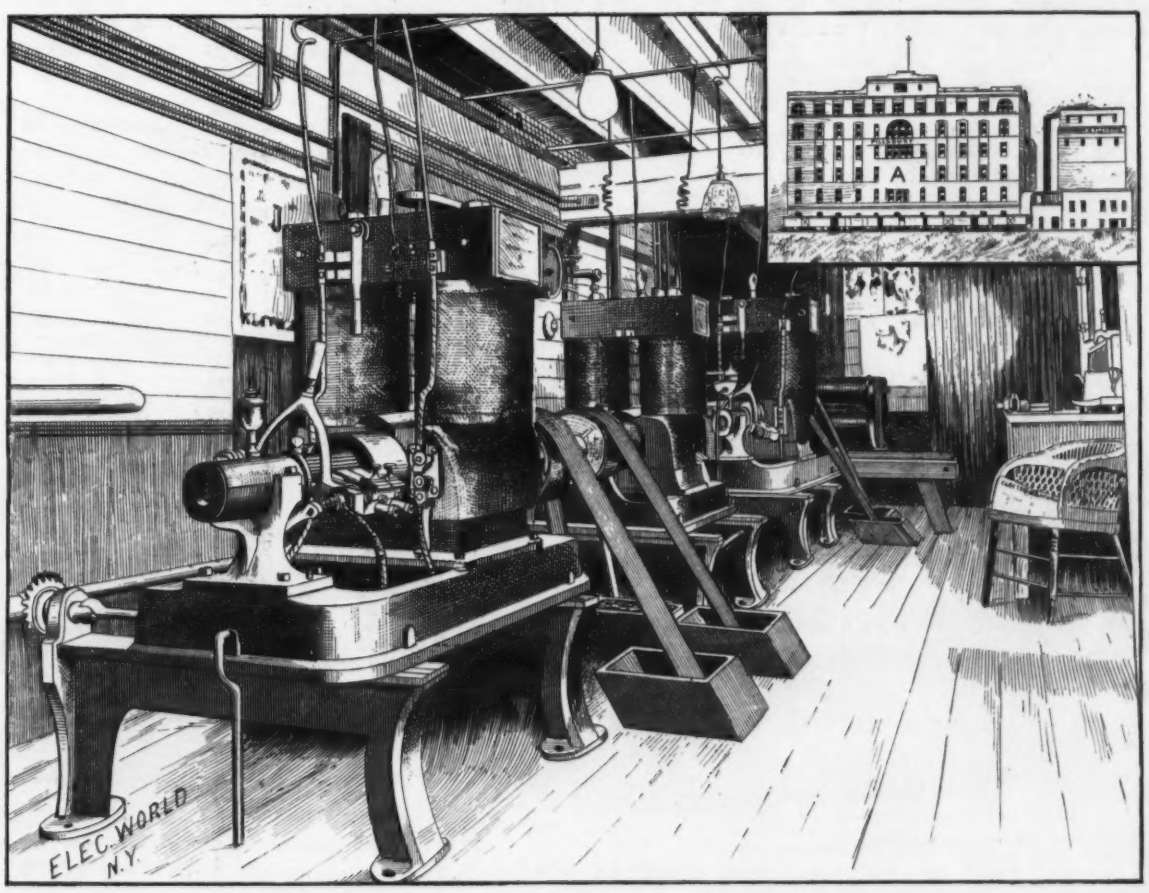
The motor is controlled from either end of the car by two separate and distinct mechanisms, one of which is a cylindrical contact switch by which the speed of the motor is governed, and the other is a make-and-break switch that is controlled by the brake that stops the car. The cylindrical switch has five contact points by which a varying speed is given to the motor and a very slight movement, sufficient to throw the contact point of the switch off the contact-button, will cut the motor out of circuit and stop the movement of the armature. The brake is a rachet brake and has connected with it a snap-switch which cuts out the motor, so that when the operator turns the brake and stops the car, he at the same time cuts out the motor and stops the movement of the gears.

The car carries 84 "Detroit" storage battery cells, made by the Woodrwad Electrical Company of Detroit, and is calculated to run 60 hours at an output of 7½ h. p. In addition to the ordinary method of controlling the car by a switch, the driver has under his control a push button which will accelerate the speed of the car about twice its normal speed, so that in case the car should be behind time, by simply pressing the push button he can make up lost time. The car is lighted by three 8 c. p. Edison lamps run from the storage batteries, and the signal bell is also operated by current taken from the battery.

Electricity in the Pillsbury Mills at Minneapolis, Minn.

BY T. C. H. AND E. W. K.

The mills of the C. A. Pillsbury Company are situated on both sides of the Mississippi River. Mill "A," the largest flouring mill in the world is on the east side of the river. The foundation for this mill was laid in the spring of 1880, and it was completed July 6, 1881. It has a daily capacity of 7,000 barrels of flour, and grinds 9,500,000 bushels of wheat yearly. It is claimed that this mill alone makes more flour than would feed two cities as large as New York. The Pillsbury "B" and "Anchor" mills are on the west side of the river about three-quarters of a mile from the "A" mill, and the three mills together have a daily capacity of 10,500 barrels of flour. Two hundred cars are required every day to take wheat into, and flour and offals out of these three great mills. Each mill is supplied with an engine in case of low water, as the falls of St. Anthony, with their 135,000 horse-power are not sufficient at all times of the year to supply the numerous mills.

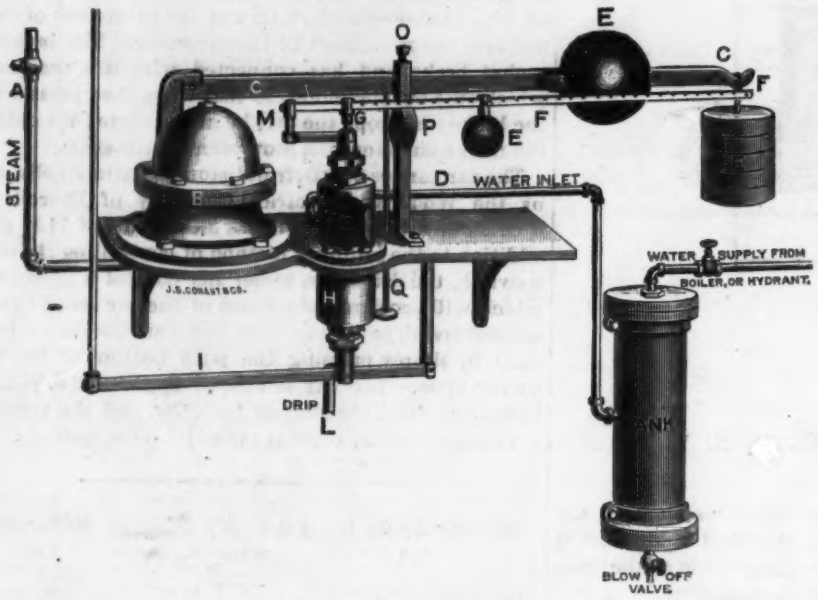


THE EDISON PLANT IN THE PILLSBURY MILLS, MINNEAPOLIS, MINN.

Most of the mills on the falls are lighted by electric light. The Pillsbury Company was the first to introduce it here, not only in the mills, but in the city. Mill "A" being new

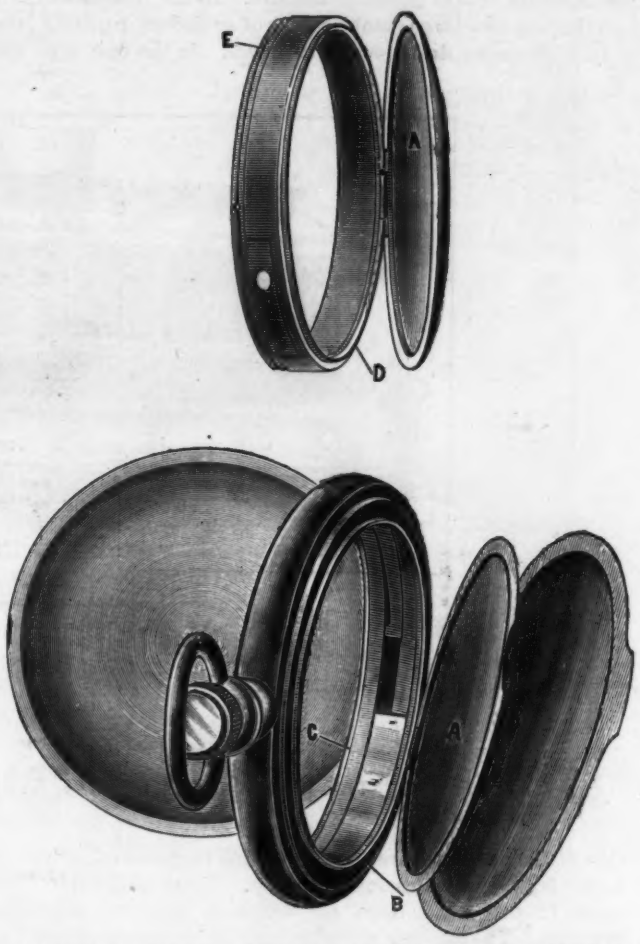
at the time, was the first in which the experiment was tried, for at that time electric lighting was still considered an experiment. The first electric machine installed was a Brush dynamo, with a capacity of 16 arc lamps of 2,000 c. p. each. Gas was also used in part, and electricity and gas ran side by side for six months. It was then decided that an open blaze, such as a gas flame, was unsafe for flour mills, especially when something safer could be had to take its place. So the 16 lamp Brush machine was replaced by a 40 lighter of the same make, and gas has not been used since electricity had come to stay.

It was now soon found that the arc light could not be divided well, and that there were a great many dark corners, there being more light than was necessary in some places and not enough in others. The incandescent light was then introduced and was found to be just the thing that was wanted. A Weston machine of 225 16 c. p. lamps was first installed, and the following year two Edison dynamos of 150 16 c. p. lights each, were added, as by that time the company had become



FIGS. 1 AND 2.—THE SPENCER DAMPER REGULATOR.

per month in battery material is effected. There are 65 bells in the "A" mill alone. On the circuit of the call bells there are switches to change from battery to dynamo as a battery is kept ready at all times; but not being used much it lasts a long time. There is also an electric fire alarm so arranged as to automatically throw itself on and



FIGS. 1 AND 2.—GILES ANTI-MAGNETIC WATCH SHIELD.

desirous of electrically lighting the two smaller mills on the west side of the river, for which purpose the Edison three-wire system was used.

The dynamo station situated on the east side of the river adjacent to the "A" mill, is shown in the accompanying engraving. The Edison 150 lighters are furnishing 141 16 c. p. lights to the "B" mill, 90 to the "Anchor" mill and 147 to the "A" mill. The distance to the mills on the other side of the river is ¼ mile, that is, from the dynamos to the lamps; and and on the east side it is 300 feet. The total number of lamps the Edison machines are furnishing is 378 of 16 c. p.; *i. e.*, 78 more than their rated capacity. This is due to the use of the new Edison lamp which requires only ½ ampère, while the old lamp took ¾ ampère. The following year there was an addition to the plant of another Edison machine of 300 lights of 16 c. p. each, which took the place of the 40-light Brush machine. The dynamos have a separate water wheel so that they can be operated when the mill is not running. There is also an engine ready in case of low water.

Besides the employment of the light for general illumination it is made use of for a number of special purposes. Thus there are twelve or fifteen millwrights at work all the time, who are provided with lamps and flexible cord connections which can be inserted in the nearest lamp socket, and so bring the light close to their work. Lanterns were formerly used for that purpose, but they are now a thing of the past.

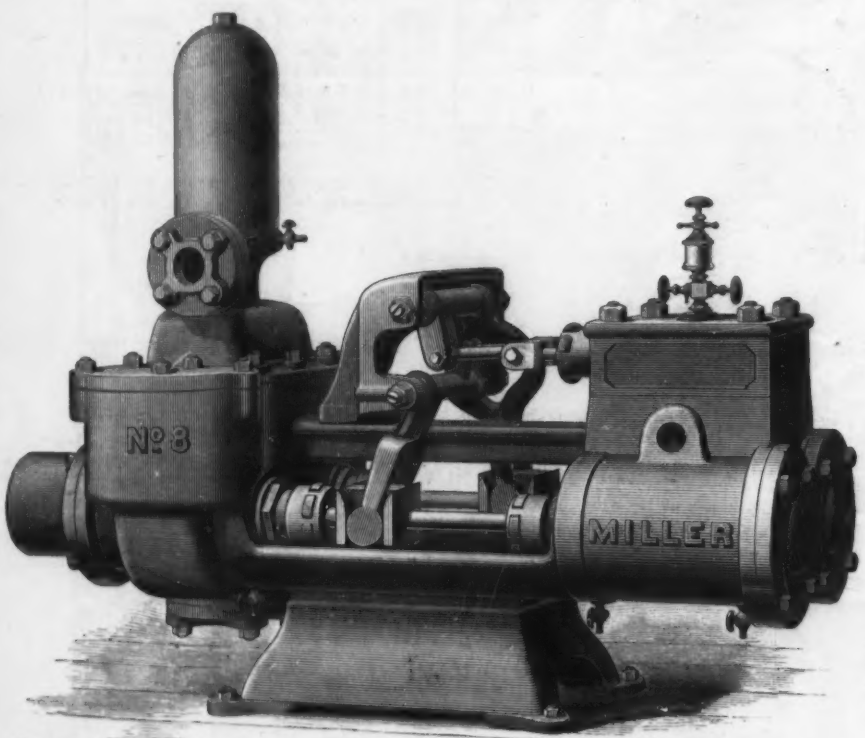
The bolters also use the lamps to look over their cloths. The small holes in the bolting cloth which need mending are ordinarily hard to find, and the little electric lamp which can be held in the hand and carried to the very spot where needed, is found to be a great convenience.

But it has been found out that dynamo-electricity could be used for other purposes than lighting in the mills. Thus one very important use is that for "raising" bread, which is one of the methods employed for testing the quality of the flour. This is done in an oven heated by electricity. The "dougher"—as the man who attends to that work is called—when he wants his oven warm, merely turns a switch and in a few minutes the oven is heated, and at the same time the temperature can be perfectly controlled.

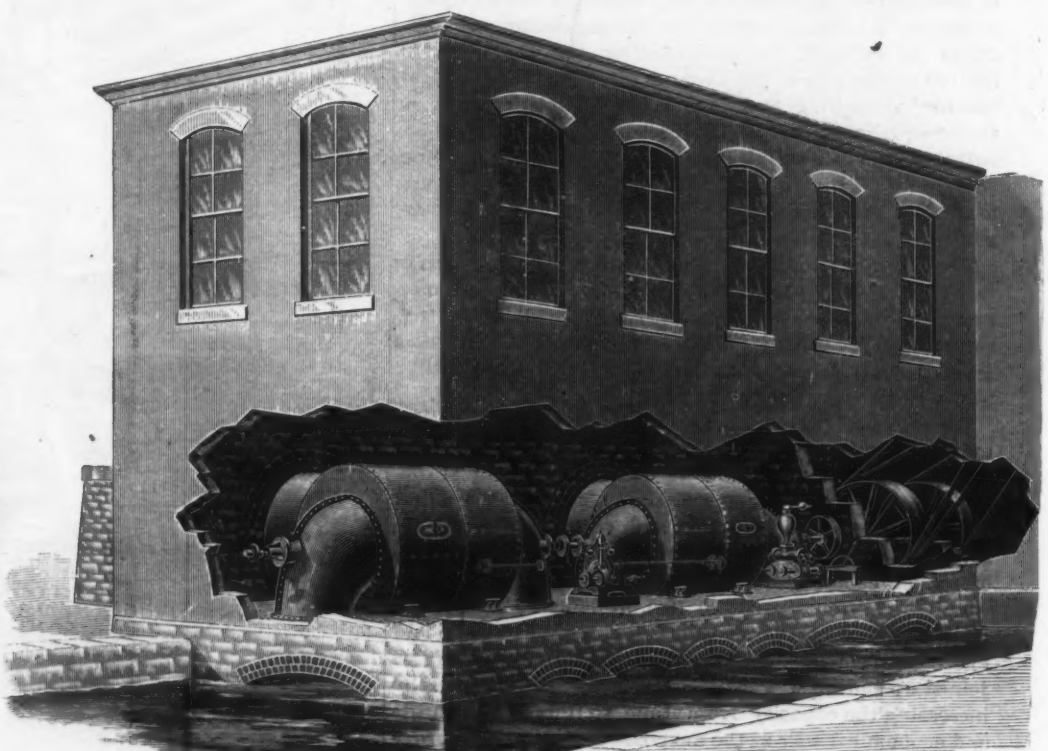
In addition to this, the dynamo current is employed for ringing all the call bells, by which a saving of about $80 off the dynamo to the battery, so as to be always on one or the other working circuit.

The dynamos run day and night, and on some occasions have run as long as two months without stopping, and could probably be run continuously for a year if it were necessary. Indeed, there has not been a single instance since the incandescent light was put in that the mills have been without light through any fault of the electric light machinery.

Naturally such highly inflammable property as a flour mill must be well guarded from fire, both by automatic devices and the constant patrol of watchmen. For this purpose the mill "A" is provided with a very fine fire-alarm and watchman's clock, which cost $2,800. There are forty stations, and four watchmen punch a certain number of stations every hour. There are thermostats placed every twenty feet throughout the mill, and in every elevator head besides, so that a belt cannot be stopped very long and heated up before an alarm is sent in. There are also 150 small box-annunciators, with one drop each, in connection with the thermostats which are located in the elevator heads. These annunciators are located close by each head, so there is no mistake or delay in finding out



THE MILLER PUMP FOR CENTRAL STATIONS.



INSTALLATION OF WATER POWER, AT CLIFTON, S. C.

which belt has stopped or got hot. These annunciators are divided into eight sections, each section or circuit running to another annunciator situated in a central part of the mill on the sixth floor. In connection with this there is another annunciator, situated on the grinding floor, which has 25 indications. This one gives the same indications as the one above, and also gives other indications from other parts of the mill.

There is still another alarm which is more general throughout the mill. This is located on each floor in the centre of the mill. This is a seven-drop annunciator, which indicates six floors and the basement. This has a double set of 10-inch gongs. There are also two single 7-inch gongs on the same floor at each end of the mill. In the basement there is an annunciator and bell to indicate hot journals, which indicates for six circuits. The thermostats which are used for sending in the alarm are made especially for that purpose. It would thus hardly be possible for a fire to get started in the mill before it would be discovered. The fire alarm system is inspected daily and is kept in the best order.

In conclusion, it may be remarked that as the Pillsbury Company were first in introducing the electric light in Minneapolis, so were they the first in other improvements and reforms. It was they who first made the experiment of dividing the profits of their mills among their employés, which they began to do in 1885, and last year there was $40,000 divided among the men, in proportion to the wages they receive and the responsibilities connected with the positions they hold, which plan has proved very satisfactory.

The Spencer Damper Regulator.

It has long been recognized that one of the chief elements of success in electric lighting lies in the economy which can be reached in the coal consumed, since this is the largest running expense connected with a central station. Hence any device by which this economy can be increased is of prime importance, and among such apparatus the damper regulator has been found to take a high place as a great assistance to the intelligent fireman; and, on the other hand, as of still greater value where the fireman lacks intelligence or is careless.

Our illustrations, page 104, show the Spencer damper regulator. Fig. 1 is the general arrangement, and Fig. 2 an enlarged section of the working cylinder *H*, Fig. 1.

The operation of the regulator will be readily understood. The weights *E E* being set at the steam pressure desired, say 85 pounds, the levers *C*, *F* and *I* would be at half stroke and the damper *K* half open, as shown. If the steam should rise but a very little, say ⅛ of a pound, levers *C* and *F* would rise correspondingly and by connection of lever *F* to the valve stem *G* open the upper port *E* in the valve body *G* to the direct water pressure from pipe *D*. The water passes through the direct port in the water packing *H* and piston heads to the chamber *F* below, forcing the piston up and with it lever *I*, moving the damper towards the closed position. Water is exhausted from the upper chamber at this time, through the opposite port *E*, passing by the exhaust end of the valve into hollow piston rod *K* to drip *J* and out. The fulcrum *M* of lever *F* being attached to piston rod *K* moves with it. The piston and valve body *G* overtakes the valve, and gradually closing the open port, cuts off the flow of water, thus making a partial stroke, or a full stroke should steam continue to rise. The reverse action takes place with falling steam pressure.

In whatever position the piston may be, no amount of power, such as the back lash or flop of larger dampers, can move it, as the piston heads of five square inches each are cushioned on water of at least forty pounds pressure to the square inch. The water used on the average is about one quart an hour only in extreme cases. The regulator will open wide or close on a variation of one pound steam and holds the damper positively at any point that the pressure requires. Mr. G. G. Stillman, of Lynn, Mass., is the agent for this useful appliance, which is already largely in use by electric light companies.

Utilization of Water Power at Clifton, S. C.

Now that the utilization of water power for electric light and motor purposes has become of such great importance, the illustration, page 104, of a large plant of Victor turbines put in by the Stilwell & Bierce Manufacturing Company, of Dayton, O., will be of interest. It represents a portion of the new 24,000 spindle cotton mill designed by C. R. Makepeace & Co., cotton mill engineers, Providence, R. I., for the Clifton Manufacturing Company, Clifton, S. C. A portion of the wheel-house is broken away to show the water-wheel plant, which consists of two pairs of 48-inch Victor turbines on horizontal shaft, working under 18 feet head and capable of developing 980 horse-power. This entire plant is of the most modern and substantial character. This plant could be well adapted to driving a number of dynamos by placing pulleys between and at both ends of the wheels and belting direct, and, if we are not mistaken, the Clifton Company has already installed its lighting plant in this way.

The Gilés Anti-Magnetic Watch Shield.

We have already described the Giles anti-magnetic watch shield, in which the watch is protected from external magnetic influences by being entirely encased in iron, which leads or bends all magnetic lines of force around the works and thus protects them. The illustrations, page 104, show the simple manner in which the shield is applied. The engraving, Fig. 1, represents the ordinary case before being prepared to receive the shield. The back cap *A* is removed, as it is replaced by the shield cap. The back cap snap *B* is then turned out, and is replaced by the shield snap *D*, and the bezel snap *C* is replaced by the shield snap *E*, which is reduced to almost a knife edge, as seen at *E*, Fig. 2. The bezel snaps on the shield box, and the back shield cap also, thus making a complete dust-proof box for the movement, and a support to the case also. The body of the shield box displaces a portion of the springs and joint blocks, as is seen to fill the case centre in Fig. 1, so that but a thread of the case metal, the two knife edge snaps, are turned out.

The Miller Duplex Pump.

Our illustration, page 104, represents the Miller duplex pump designed especially for boiler feeding, and which has been introduced into a number of electric light stations. The piston rods of these pumps are made in two parts, and connected at the cross-head so that the steam pistons or water plunger can be removed without in any way interfering with the other parts. The piston rods on the steam end are of cold rolled steel, and for the water end noncorrosive; very hard composition metal rods are used. By this means no rust or other action of the liquid can take place. The bearings of the levers are chilled and case hardened, and their arrangement admits of the wear being taken up centrally while the pump is running. The position of the levers is not changed by adjusting, so that the stroke is always kept the same. The cylinders on the water end are of very hard composition metal.

A very handy and convenient arrangement is employed whereby the packing in the water cylinder can be adjusted to wear, or the plunger repacked without trouble. There is ample space in the stuffing boxes for packing, etc., and by reference to the cut it will be seen that all the stuffing boxes and every screwed part is very accessible. The valves on the water end are designed to withstand heavy duty, and they can be easily and quickly removed when found desirable, while the pump is in motion, as can also the valve seats, without disturbing the other parts.

The pump is manufactured by the Canton Steam Pump Company, of Canton, O.

Lightning Arresters and the Photographic Study of Self Induction.*

NOTES ON MR. E. G. ACHESON'S PAPER, BY JOS. STANFORD BROWN AND CHARLES T. CHILD.

Having been requested upon very short notice to re-open the discussion on the highly interesting paper on "Lightning Arresters and the Photographic Study of Self Induction" presented at the Institute meeting held Jan. 8, the following hasty notes and queries are with diffidence offered for consideration. Truth alone is sought, and it is a matter of regret if any criticism should even tend to disparage the worthy endeavors of one who has so fearlessly grappled a problem fraught with such interest alike to both theorist and practical electrician.

After careful reading it would seem as if the subject might be approached with advantage from more than one standpoint, and that even somewhat different conclusions were deducible simply by rearrangement of the experimental data. We have given, a submarine or subterranean cable, to each end of which at its junction with the main line a lightning arrester is connected in the most approved manner, Fig. 1; to determine why, in spite of these precautions, the cable is not infrequently punctured when an "electrical discharge" enters the overhead system.

For experimental purposes this has been reproduced in miniature, as shown in Figs. 2, 2a, 2b and 2c, by the line *L* entering the cable *K* at the point *P*, to which point is attached the lightning arrester *C* grounded through the wire *W*. The "electrical discharge" arises from the Leyden jar *J*, charged from the Holtz machine *M N*, and strikes the line at *A*. The outside of *J* will represent the earth, to which the ground wire *W* and the "earthing" of the cable, represented by *E*, "twisted a single turn" about the cable, is connected. Is it not possible, then, to throw Fig. 2 of the previous paper into the form Fig. 2a for the purpose of drawing attention more directly to the relation of the circuits involved? The discharge, or momentary current, from the jar *J* entering at *A* traverses the line *L* to the point *P*, where two paths are offered; one, through the lightning arrester *C* to earth *E*; a second, in practice, by puncturing the cable insulation. *C* now being made but a fraction of the insulation thickness, and *W* a short, thick copper wire, it was found that the cable was still frequently punctured at times when a spark appeared at *C*, and that the length of *W* appeared to enter the effect equally with the space variation of *C*. *No part of the effect*, it will be noted, *is attributed to the action of the cable as a condenser*.

The problem is now changed to that shown in Figs. 3 and 3a, presenting a divided circuit with the lightning arrester at a constant distance of .02 inch and the earth wire *W* long compared with that connecting the variable *B* space with the same earth point. May not this arrangement of split circuit with an air space in each branch be looked upon as the general case for which Dr. Lodge's "alternative path" represents the condition of making one of the air spaces zero? What then is the relative efficacy of changing the length of *W* and the distance of the *C* points *to prevent* a spark at *B* which represents the puncturing of the cable insulation, providing the *B* points are held equivalent to the long length of cable wire at any point of which puncturing may occur?

To decide this with *A* and *C* fixed at .286 and .02 inch, respectively, *B* was varied with *W* to keep the spark ratio of *B* to *A* constant at one to ten. Then removing *C* (*i. e.*, for *C* equals zero) the operation was repeated, and a comparison of these results is shown in the curve, Plate *A*. Instead of this procedure, should not *B* have been made non-sparking for *C* and *A* fixed, and *W* varied until a spark was got at *B*, and then *W* left constant for variations of *C* up to a point where *B* would spark?

That with the connections of Fig. 4 and *W* equal 20 feet a spark should pass at *B* of over ⅛ inch in length might perhaps have been expected from Dr. Lodge's results (London *Electrician*, XXI., 815), shown here in Fig. 4b, when there is an alternative path in which the self induction of *W* (Lodge's *L*° loop) comes into play. True, Fig. 4 is not an "alternative path" of necessity, for the *B* points may be moved out of the sparking distance.

W is now supposed "electrified" by the charge across *A*. The "inverse extra current" of making simply cuts from the charging current; but the "direct extra current" of breaking, *i. e.*, charging impulse cessation, acts as its continuation but at a higher potential (Ganot, 7th edition, 776). This extra current then is running toward *E* and would naturally be supposed to equalize on the same path as the current generating it. It might therefore be expected to dissipate on reaching earth; the circuit is however, claimed to close itself through *P W E B*, or, more clearly, around the closed circle of the *L*° loop, Fig. 4b.

It would be of interest to some in this connection to know how it was ascertained that the instantaneous time duration of the extra current is shorter than that of the charging current; for if this be assumed, because of the known higher electromotive force of the former, the argument would seem to be in a circle.

* Read before the American Institute of Elec. Eng., Feb. 12, 1889

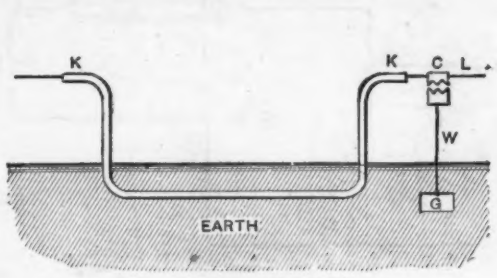


FIG. 1.

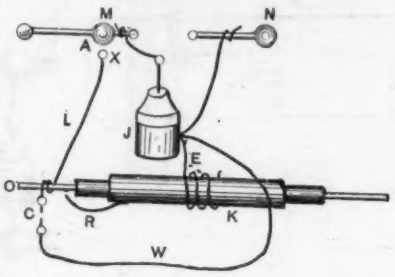


FIG. 2.

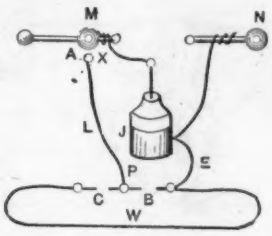


FIG. 3.

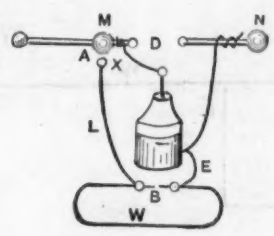


FIG. 4.

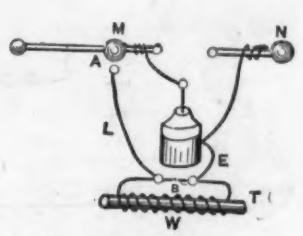


FIG. 5.

LIGHTNING ARRESTERS AND THE PHOTOGRAPHIC STUDY OF SELF INDUCTION.

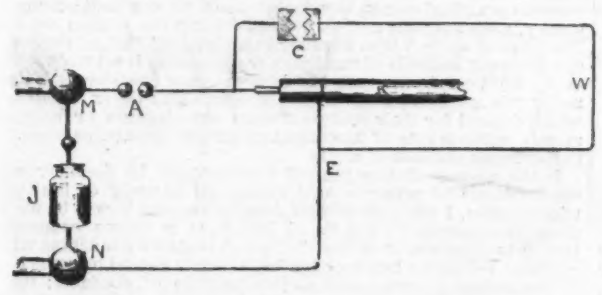


FIG. 2a.

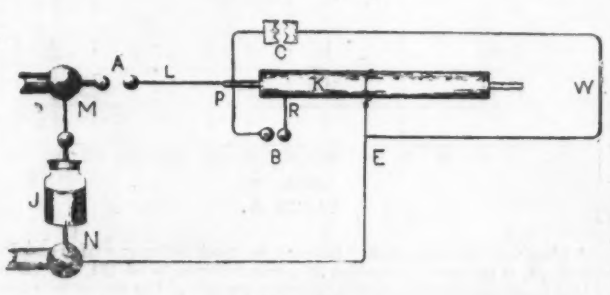


FIG. 2b.

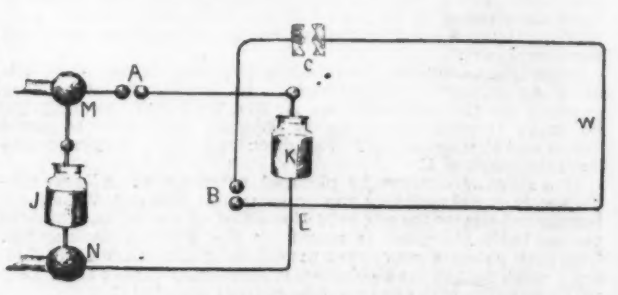


FIG. 2c.

On the assumption that the extra current dissipates through *B*, and not in the earth, it is argued that shortening *W* would tend to decrease this tendency to puncture the cable. To test this we have *B* equal the insulation thickness, *C* and *W* removed, and we get Fig. 2b if the *C W* circuit be supposed omitted. "With this arrangement it was not found possible to puncture the cable." May not this be regarded simply as a safety short circuit for our cable considered as a Leyden jar? And what is this but a working case of a cable effectually protected by a lightning arrester *B*? While the electrostatic capacity of a "short piece of cable" may be negligible compared with that of twenty feet of No. 16 *B. S.* wire, it is perhaps doubtful if the capacity of a commercial cable could be so regarded in comparison with that of the ground wire from the lightning arrester.

It is not altogether plain how the direct extra current is an effect of Faraday's electro-tonic state when Faraday says (*Researches*, I., 16): "This state is altogether the effect of induction exerted, and ceases as soon as the inducing force is removed. And Jaquez ("Dictionaire d'Electricité et de Magnetisme," 1887, p. 138) defines it as "the state of the conductor during the interval of time which separates the appearance and disappearance of an induction current." Maxwell, by the way ["Electricity and Magnetism" (2d Ed.), II., 174], calls it "the fundamental quantity in the theory of electro-magnetism." Would it not be possible to

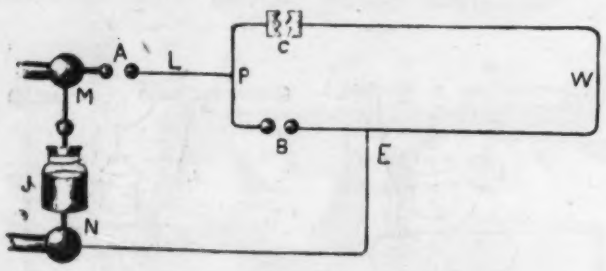


FIG. 3a.

regard it as an electro-magnetic potential stored in the wire ready to show itself as direct extra current? With the citations quoted above, how can this electro-tonic state exist *before* the electrifying current is discharged into the circuit?

Figs. 5, 5a, 6 and 6a illustrate effects of different kinds of work introduced into the circuit. For references see Fleming's "Short Lectures to Electrical Artisans," pp. 44, 45, and Gaoot, 7 Ed., 776; Maxwell, "Electricity and Magnetism," 2d Ed., II., 211; Dove, Poggendorff's *Annalen*, vol. xlix., 1840, etc.

The methods used in the photographic part of the investigation would seem to cast some doubt on the results claimed. The effects noted deal chiefly with the prolongation or diminution of the current wave of the jar discharge by the secobmic resistance cut into the circuit. Might not a large element of uncertainty be introduced in the plates by the different degrees of illuminating power possessed by the sparks and by the irradiation of the plate?

In the cases when the discharges are through 76 feet and 20 inches of the same wire, respectively, hardly any difference appears in the spark. Is it not possible that the illuminating power of the quick bright spark through the short wire was so much greater than that of the necessarily more extended and consequently fainter spark through the long wire as to make the effect practically the same?

In the experiment in which two spark intervals are included in the circuit, as against one, formerly, it was found that the spark was materially lengthened. This might be expected considering the practically infinite resistance of the second air space which is introduced. The spark length too was found inversely proportional to any form of work introduced in the ground wire circuit. Possibly the photography of spark durations is not altogether the best method of measuring them. It is not yet by any means certain that a sensitive plate is equally affected by small equal time intervals at the beginning and end of the exposure, nor is it improbable that with sharp-edged holes moving at an extremely high velocity some diffraction phenomena might intervene that would introduce serious errors in the photograph. It is, besides, very difficult to measure the faint trails of light left by the spark. On the negative they are practically invisible and in the prints their extreme delicacy and the fact that they fade away into the surrounding blackness without any sharp line of demarcation renders them almost impossible of measurement. On these grounds the measured spark distances of the first part of the article are probably more trustworthy as a basis for theory than the photographic results of the second part.

Returning to our original problem, why may not the cable, acting as a condenser, puncture itself in discharging, it having been charged by the current from *A*, Fig. 2c, which, meeting the lightning arrester, backs up its potential until able to strike across and thus to ground? This discharge occurs simultaneously with the spark at *C*.

If a wave of current be pictured passing along a linear conductor, it would probably appear something like Fig. 7, its front lengthened out by the self induction effect of the cable, while the tension in the rear part is raised by the direct extra current. This high potential wave crest moves along the cable until, finding a weak spot in the insulation, it discharges rather than keep up its strength with the impeding current ahead of it.

It is hoped to be able to present at some future meeting the results of certain experiments delayed so far by pressure of professional engagements.

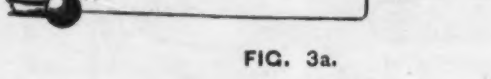


FIG. 4b.

Electric Meters for Central Stations.

On Wednesday last, writes our London correspondent under date of Jan. 30, Prof. George Forbes, who has just returned from a tour of inspection of the principal central lighting stations on the Continent, delivered an interesting address before the Society of Arts on the subject of "Electric Meters for Central Stations." In the course of his lecture Professor Forbes remarked that he had found one maxim which was firmly believed in both in Europe and America, namely, that the best paying stations are those in which the electricity is charged for by meter and *not* at so much per lamp per annum. Professor Forbes disposed of the proposal to measure quantity of energy in lieu of quantity current by hinting that if this were done the companies would be tempted to overrun their lamps to the benefit of their own pockets and to the detriment of the customers. A formidable list of 15 "desiderata" which go to make a perfect electric meter was then given, and as perfection is a thing we no doubt all aim it, it may interest your readers to learn what constitutes the ideal in this particular instance. "1. *Accuracy.*—The meter must be at least

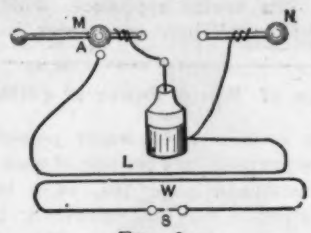


FIG. 6.

as accurate as an ordinary gas meter. The readings should be quite accordant; when we take 10 times as much current out of the meter, we ought to get exactly 10 times as large a reading in a given time; the indications of different meters must be consistent.

2. *Range.*—It is desirable that the meter should be capable of working accurately over a large range of current strength. It would undoubtedly be desirable that the meters made for the largest currents which can be used on a circuit should also be capable of indicating correctly when only one lamp is in circuit.

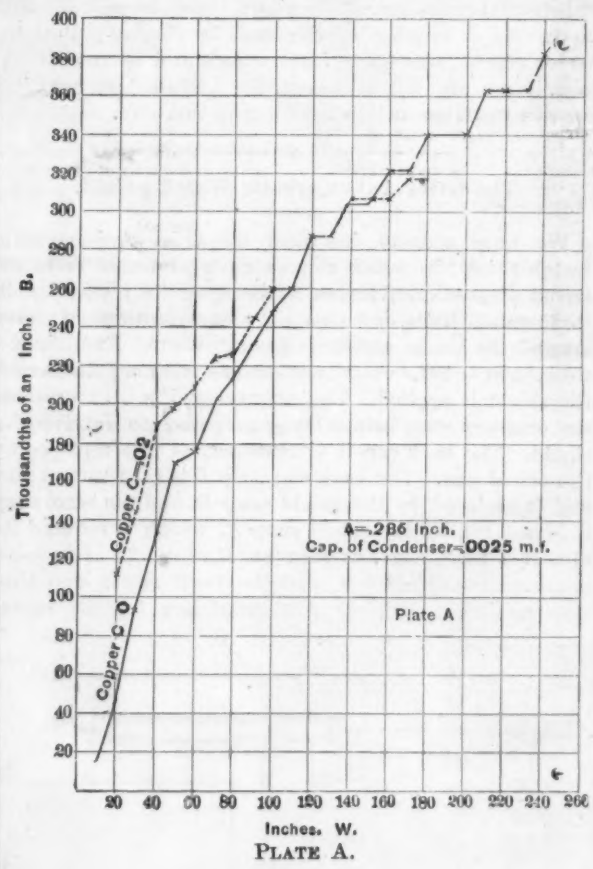


PLATE A.

A plan which is adopted, I believe, in most stations which employ meters, is to wire the houses in separate circuits of 20, 40, 60 or 100 lamps, according to the effective range of the meter adopted, and use a separate meter for each of these circuits. 3. *Consumption of Energy.*—Energy must not be consumed by the meter to such an extent as to diminish injuriously the voltage supplied to the lamps. The wiring of a house immediately diminishes the voltage at the maximum about 2 per cent., according to present practice in this country. A meter ought not to increase this loss by more than ⅛ per cent. 4. *Simplicity.*—The meter should be simple to construct, and not liable to get out of order. 5. *Durability.*—It is essential that no parts of the apparatus are liable to wear out rapidly. 6. *Attention.*—Other things being equal, that meter is the best which requires least attention. 7. *Registration.*—The meter should register in a clear manner, so that the consumer can read it at any time and check its accuracy. 8. *Testing.*—A point of some practical value is that it should be an easy matter to test the meter, and that the operation should not occupy much time. 9. *Cheating.*—With some meters the process of cheating is easier than with others. I speak chiefly of cheating on the part of the consumer. I notice that generally when I have been speaking about meters with people the other possible way of cheating is not considered of much importance (renewed laughter). The possibility of short-circuiting the meter is common to all, and can be obviated. Some meters can be retarded by placing a magnet near them, others by heating them locally, others by putting them out of level. 10. *Economy.*—It is very desirable that the meter should not be a very costly apparatus. 11. *Freezing.*—A meter which contains a liquid which can freeze is objectionable in any but warm countries. 12. *Alternating and Continuous Currents.* A meter which reads with equal accuracy for both kinds of current has a double value. 13. *Number of Alternations.*—Meters for alternating currents ought to indicate with equal accuracy, whatever be the alternations per second. 14. *Contact-breaking.*—No contact-breaker of any electric circuits should be allowed in a meter, because such contacts deteriorate with use. 15. *Mailing.*—The meters should be so subtantial that they can be sent by rail without accident."

Professor Forbes next proceeded to describe some half a dozen well-known meters, including the Edison and Schallenberger instruments, and one, the Aron meter, which is largely used in this country and in Germany. Before concluding his address, Professor Forbes took advantage of the opportunity to protest against the practice, which obtains in this country, of rating an 8 c. p. lamp as the normal one. "Every one," he said, "is dissatisfied with the low candle-power prevalent in London, and, as a general rule, 16 c. p. lamps have been found in actual experience in hundreds of central stations to be the most suitable."

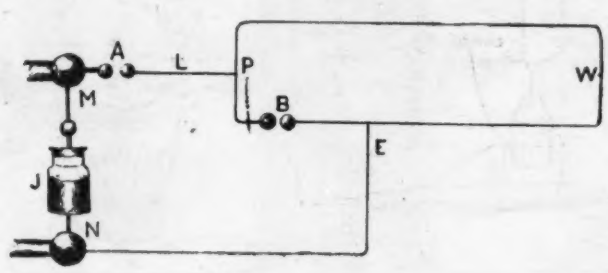


FIG. 4a.

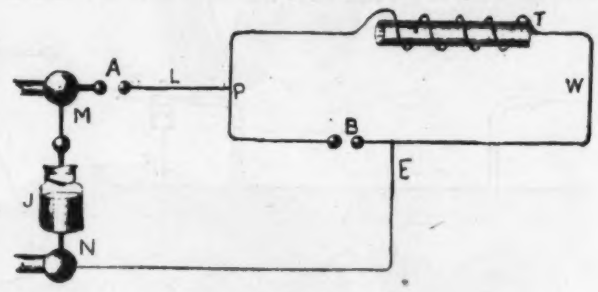


FIG. 5a.

From the remarks which he let fall in the course of his lecture, it would seem that Professor Forbes has been greatly impressed by all he has seen on the continent. The lighting of the "Unter den Linden" at Berlin "is the finest piece of street lighting ever accomplished," the central station at Milan is "splendid," and that at Rome "is in many points the finest and best designed station for alternating currents" which Professor Forbes has ever seen. A short discussion followed the lecture, in which Mr. R. E. Crompton and Professor Ayrton took part. Mr. Crompton thought that if Professor Forbes had had practical experience in lighting private houses, he would not have advocated 16 c. p. lamps so strongly, as in this country, where electricity had to compete with gas, 8 c. p. lamps placed in passages, halls, and so on, answered extremely well, and helped to keep down the annual bill. Professor Ayrton expressed a wish to break a lance with Prof. Forbes on the question of ergmeters vs. coulombmeters: "He did not care about volts, watts or anything else; he bought light and wanted a meter to measure what he was paying for. A variation of 2½ per cent. in volts meant a considerable drop in the light, which was about proportional to the cube of the volts, minus a constant." Prof. Ayrton also referred to the motor meter designed some time back by Prof. Perry and himself, and to an "evaporation" meter, similar to that of Prof. Forbes, upon which Mrs. Ayrton had for some time been experimenting. The discussion was closed by a short speech from the chairman of the meeting, Mr. W. H. Preece, who declared himself in favor of 8 c. p. lamps and advocated the adoption of the system of denominating lamps by the watts they consumed and not by their candle-power.

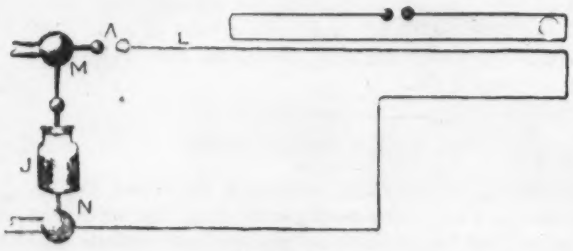


FIG. 6a.

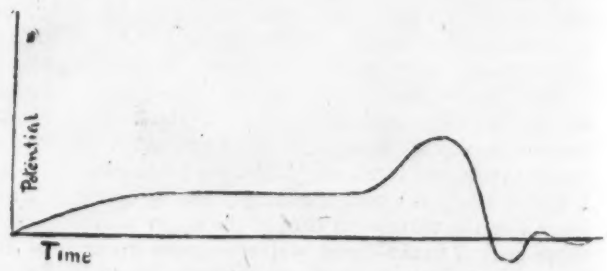


FIG. 7.—FORM OF CURRENT WAVE.

A New System of Multiplex Telegraphy.*

BY LIEUT. F. JARVIS PATTEN, U. S. A.

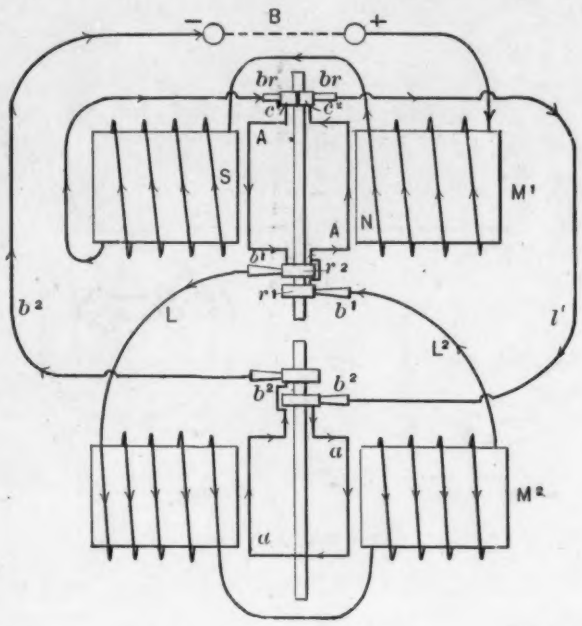
The paper this evening has a single object, its purpose being to describe the salient features of a system of multiplex transmission by telegraph, and as the system is still in the experimental stage, I shall have more to say concerning devices thus far used wherein practical results have come near to the indications of theory, than as to the actual possibilities of the system in use. The general subject is so familiar to all present that a review of the different methods of multiplex transmission is scarcely necessary. Suffice it to say that the system under consideration falls under the general class of synchronous multiplex telegraphs which depend for their operation upon the absolute or approximately uniform rate of movement of similar apparatus placed at the different stations of a line.

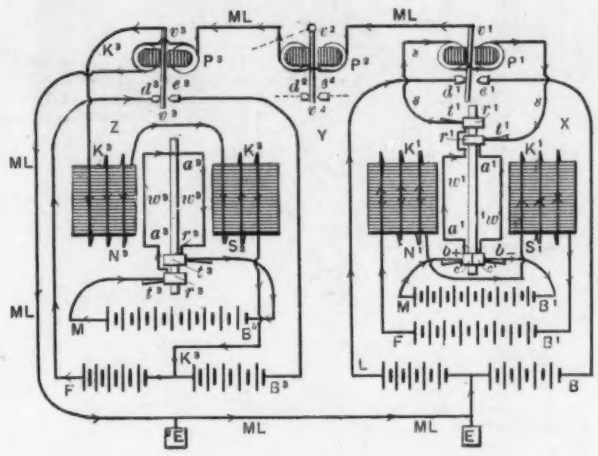
In the interest of those present who may not be familiar with the fundamental principle underlying all systems of multiplex transmission, I will give a brief description which will be understood by reference to Fig. 9. A line wire is shown connecting two distant points, at each end of which is placed a machine which carries a revolving brush or trailer, which is caused by some form of mechanism to sweep over a circular table of contacts; this is sub-divided, as shown, into a convenient number of segments insulated from each other. Each of these segments is connected to a branch circuit, which includes all the necessary instruments for a single operator sending or receiving. If we consider the trailer motionless and resting on, say, the segment No. 10, then the two operators at the end of the line would each evidently find the main line connected to his sending and receiving apparatus for the time being, and if the trailer remained in the position shown they could hold uninterrupted communication with each other. If, now, the trailers were moved to the segments No. 15, in each distributor, then operators No. 15 at each end would have the line It will now be understood that if by any means the trailers could be revolved uniformly around the circle the line would be given in turn to each of a number of operators in succession. Evidently it would be feasible to move the trailers slowly from one segment to the next and so give the line in turn to any number of operators connected, in the manner described, to the main line.

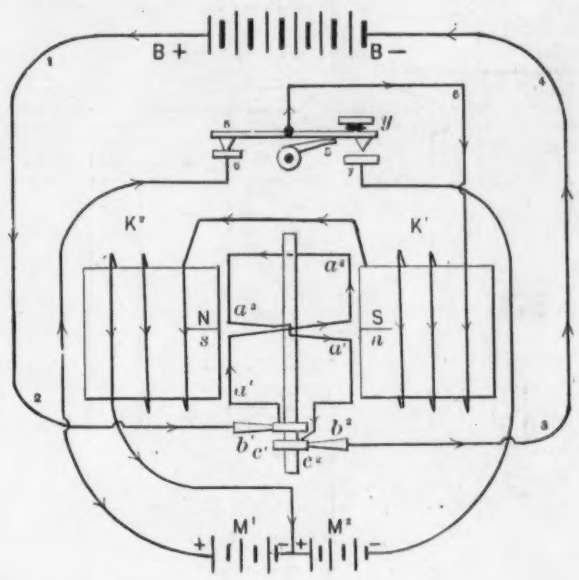
Early attempts at multiplex transmission did not go further

*Read before the American Institute of Electrical Engineers, Feb. 12, 1889.

than this. The line was given slowly first to one and then to another operator, the time that each in turn could hold communication being indicated by a common metronome. Later attempts went further than this, the idea being to make the trailers revolve at a high rate of speed, moving in fact, so fast, that each pair of operators in turn is connected to the line so fast that he is practically unaware that the line has ever been taken from his circuit. It is easy to see that this would not require a very high rate of speed. If it be assumed that the operator can make the shortest







FIGS. 1, 2 AND 3b.—A NEW SYSTEM OF MULTIPLEX TELEGRAPHY.

signal with his key in one-fifth of a second, it only becomes necessary to move the trailers at a speed of more than five revolutions in a second, when it would evidently be impossible for any of the operators to close a key without having the line during this interval connected to his branch circuit. In order that the signal

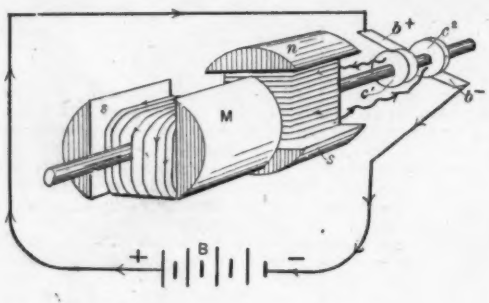


FIG. 3.

sent by any operator shall reach the corresponding operator at the other end of the line, it becomes necessary, of course, that the trailer at the two stations should be on the same identical segments at the same instant of time. The solution of this problem will then consist in causing the trailers, starting point without which any such system will remain what a noted English scientist has aptly described as a "mere figment of the intellect."

In the literature of the telegraph, already large, synchronizing devices are common, and in the books their operativeness is generally taken for granted. All such devices, with a single exception that occurs to me, are founded upon the isochronous motion of some mechanism which, under the operation of natural forces, has a fixed rate of movement, and preserving this motion unvaried so long as these forces are acting freely. The pendulum and the tuning fork perform their oscillations of great or small amplitude in the same period of time; their rate of movement is, therefore, described as being *isochronous*. Two such exactly similar devices while in motion, therefore, should be in *synchronism* with each other; but all these devices once set in motion immediately tend to a state of rest, and it becomes necessary to apply constantly some extraneous force to keep them in continued operation; they must continually receive an intermittent impulse to prevent them from coming to a state of rest. The natural rate of movement of the apparatus, which is alone the result of the uninterrupted action of the forces in the system, is thus made subject to a slight but constant disturbing effort.

In view of these considerations which have been expressed in the most general terms, it has been my endeavor to perfect a synchronizing device that should be independent of the uniform rate of motion of any part, the general statement of the problem being to devise apparatus which shall move in unison with each other at a variable instead of at a constant rate of speed. Recent electrical inventions point clearly to an ultimate solution of this problem, if it has not already been achieved. A pertinent illustration of this fact is found in the common speaking telephone, so common, that variable synchronism is already in daily use among those who regard matters electrical as full of mystery.

ture conveniently arranged for use as either direct or alternating current machines. The armature circuits were connected at one end to an ordinary two-part commutator and at the other to two insulated ring contacts. They are shown by a simple diagram in Fig. 1, where both are connected in a single circuit. The armature of the machine M^1 was normally open at the ring contacts and could be closed either by connecting the ring or through an external circuit. Such a circuit was made to include the field coils of the machine M^2, and the armature of this machine was connected in the direct current circuit from the poles of the battery. Thus connected, the two machines moved as one; the machine M^2 following all the fluctuations of speed in the machine M^1, as if their armatures were carried by the same spindle, the speed being varied between wide limits. To convert this mechanism into a synchronizing device in such a way that the machines could be placed at a great distance from each other was another step. As there was evidently an alternating current in the external loop connected to the armature of the first machine the reversals of current in this circuit must correspond in time to the half revolutions of the

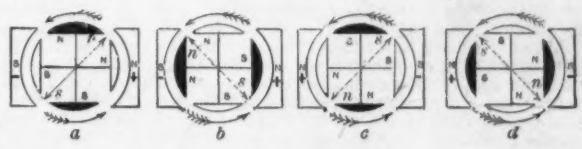
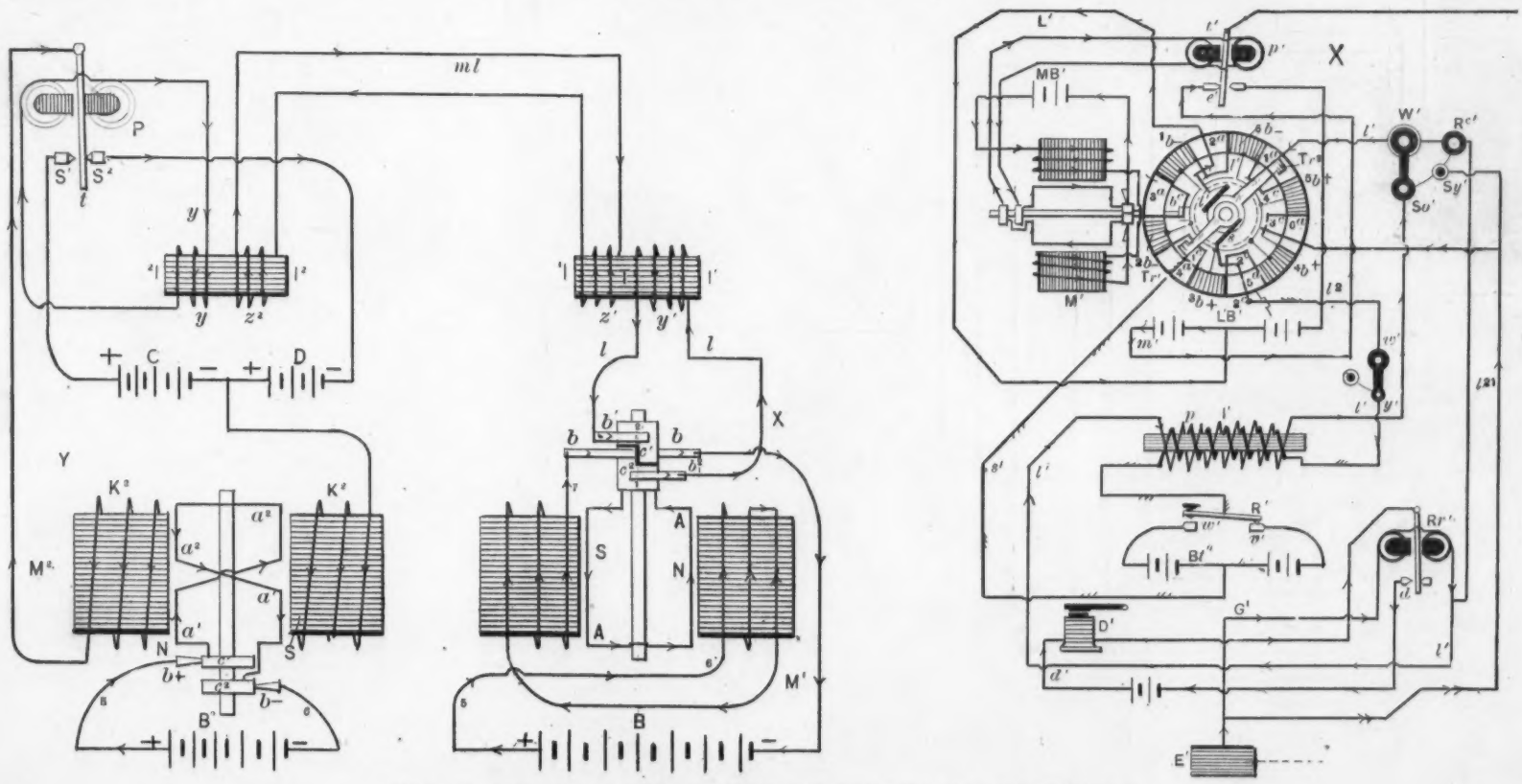


FIG. 3a.

armature of this machine and an ordinary polarized relay connected in the loop would vibrate in unison with the half revolutions of the armature in the machine M^1. The second machine could therefore be made operative at a distance by simply connecting another relay in an independent line circuit and causing the latter to reverse the current in the second machine. This arrangement, which constitutes the fundamental synchronizing device, is shown in Fig. 2. Here the first machine, placed at station X, has a polarized relay connected in the external armature circuit, and the relay vibrates in response to the reversals of current



FIGS. 4 AND 7.—A NEW SYSTEM OF MULTIPLEX TELEGRAPHY.

however far apart, to move with absolute uniformity and precision. If this can be done at a sufficiently high rate of speed then a single wire may be given in rapid succession to a number of operators at each end, and all may simultaneously communicate over the single wire without interruption or interference with each other.

Such a system has for its object the utilization of all the currents which in a given unit of time can be distinctly transmitted over a single wire. If it is assumed that in average Morse transmission five pulsations of current or makes and breaks of the circuit occur in in every second, then if n represent the number of separate currents that can be made to succeed each other during this interval of time, $\frac{n}{5}$ will represent *theoretically* the number

In this apparatus the diaphragm of the receiving instrument moves in perfect synchronism with that of the transmitter, and it seems by no means an exaggerated comparison to regard the receiver as an alternating current motor moving in perfect unison with the changes of potential in the generator and the line circuit. My experiments in this field were first directed to the application of this peculiar relation of the alternating current generator and motor to a synchronizing device, only to reach the conclusion, however, that it could not be made operative on a circuit of any considerable length.

Further experiments led to a simpler solution of the problem involving few uncertain elements.

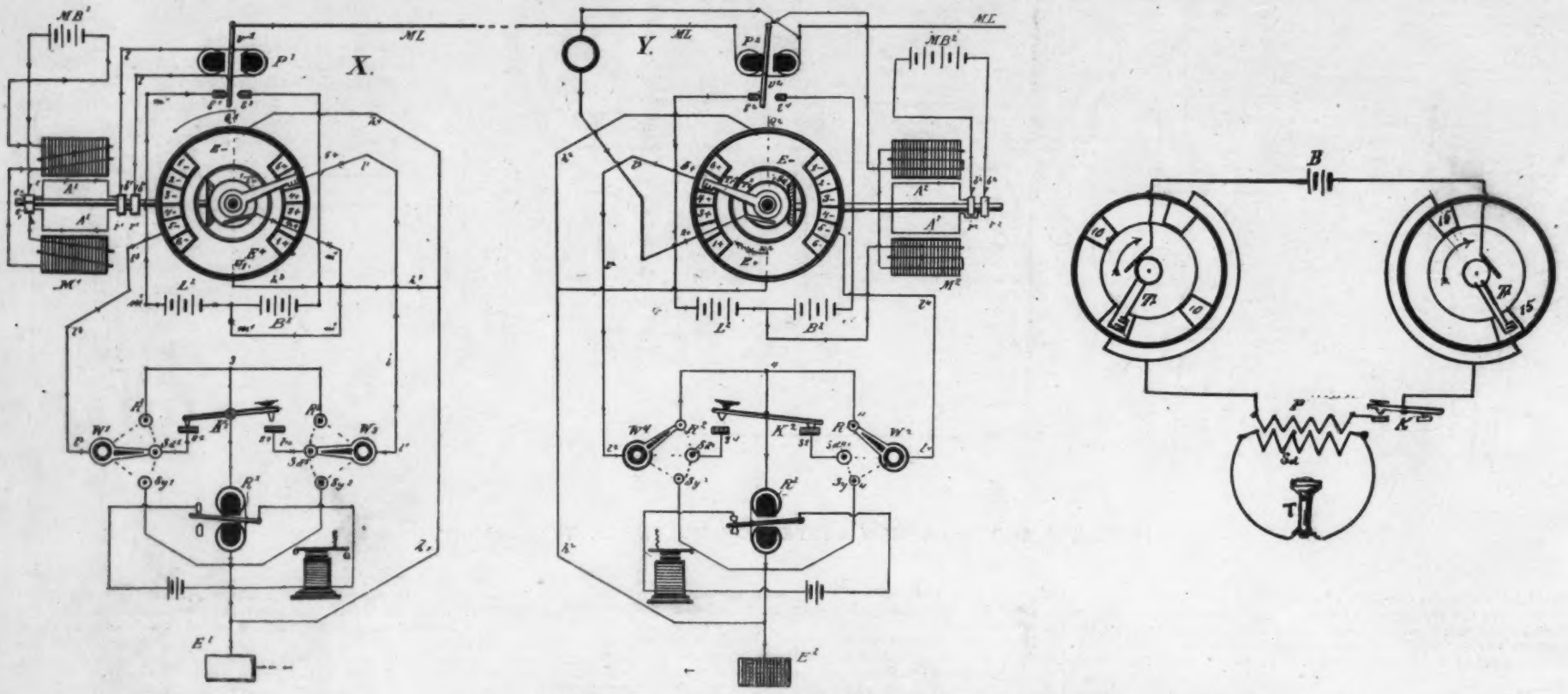
I had constructed two ordinary direct current motors of the simplest form, an ordinary two-pole field and single coil armature of this machine, which correspond accurately to the half revolutions of the machine at X. A line circuit extends from the fixed point of the relay vibrator to the distant station Z, where it includes the coils of another relay and returns to the middle point of the line battery L B at X, the opposite poles of which are connected to the contact stop of the relay at this station. From these connections it results that any relays in the line circuit will be actuated by reversed currents in unison with the half revolutions of the machine at X. At any distant station, as the one shown at Z, another machine has its field coils connected as follows: One terminal to the fixed point of the relay and the other to the middle point of a local battery, the opposite poles of which are connected to the contact stops of this relay, the armature of this machine being connected through

ring contacts and brushes to an independent source of direct current. Connected in this manner, the two machines still move in perfect unison, even at variable speeds, though separated from each other by any line resistance through which a polarized relay can be made to act. With a single coil armature the driven machine is at times quite erratic, as it can evidently move in either direction, and I have seen such machines reverse instantly at a speed of several hundred revolutions a minute, and go apparently as fast in the opposite direction, and this even when provided with a fly-wheel of moderate weight.

This difficulty may be overcome in a variety of ways; an effective one is shown in Fig. 3, which represents a form now given to a single paper. The uniform motion of distant machines is secured at rates of speed that may vary within considerable limits and synchronism is maintained independently of the isochronous motion of any device or moving part, all the machines moving in unison with a governing motor which sets the pace for all the rest. The controlling machine may evidently be any form of direct current motor carrying a revolving pole changer.

A practically constant speed is of course necessary in any application of this device to the telegraph, but as an illustration of the variable synchronism it may be stated that in a continuous run of twenty-five hours the speed of three machines connected by a single line circuit has varied uniformly between 100 and 1,000

A singular and unexpected result was deduced from this experiment. Evidently the one machine might start into synchronism at any point of the circumference, the trailers making any angle with each other, as the one shown in the diagram: a revolving switch had been provided which was so arranged that by turning it a wire could be moved from one segment to another and so adjust the circuits independently of the relative positions of the trailers. The machines were repeatedly stopped and started again, but came again into synchronism always at the same point, the wires never requiring any adjustment, establishing clearly the singular fact that the driven machine always went into synchronism at the same point and could, therefore, be



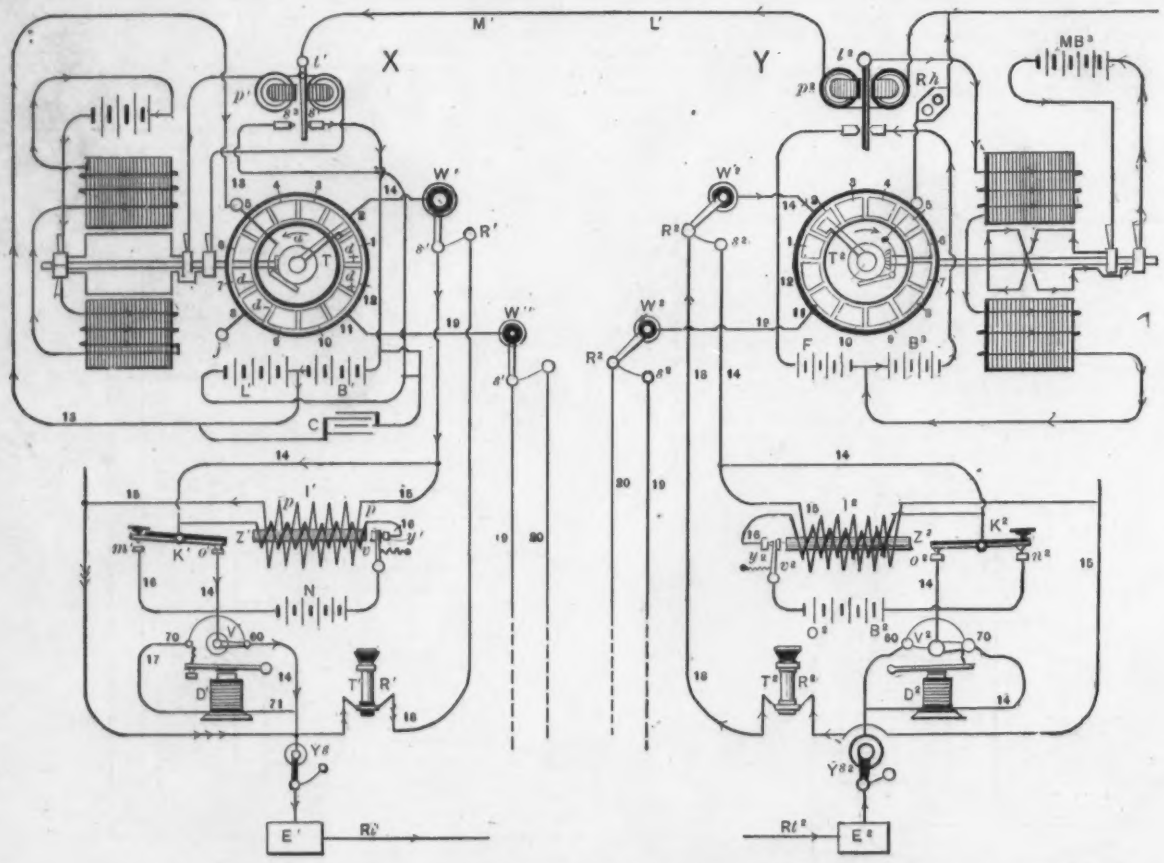
FIGS. 5 AND 9.—A NEW SYSTEM OF MULTIPLEX TELEGRAPHY.

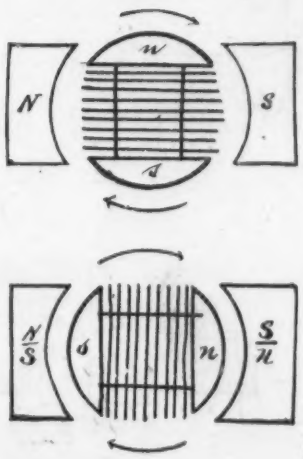
the armature of the driven machine, it has two coils in series connection, but wound with their poles at right angles to each other. This armature, being placed in a single field, I had supposed would move at only half of the speed of the first machine; but, on the contrary, the synchronism was perfect, the motion was continuous in direction and it has never been known to reverse. The analysis of its action is shown in Fig. 3a, where the armature is represented in the four successive quadrants of a single revolution, the black and the white pole pieces representing the ends of the two coils in their different positions. The dotted lines indicate the position of a pair of resultant poles which must lie diagonally between the actual poles; this diagonal line represents the resultant polarity of the armature and it is evident that neither of its actual poles could be in a position of stable equilibrium while in line with the poles of the field; the resultant

revolutions per minute. Fig. 4 illustrates a modification of the original system in which induced currents of high E. M. F. are used as synchronizing currents. The armature loop of the governing machine is connected to the primary of an induction coil, the secondary to the line circuit at distant stations, and the impulses are reconverted and caused to actuate a polarized relay as before.

A simple experiment made to determine the accuracy of the synchronism will be explained, as it led directly to a separate application of the system to the transmission of signals. The connections are shown in Fig. 9. From the battery B a line extends to the spindle of the two machines, each provided with segmental distributors of 48 parts. From one such segment in the one machine a wire was taken to a segment of the other machine, the primary of an in-

made to start in at any point of the distributor by a proper adjustment of the trailer on the spindle. The reason for this may be found by considering the relation of the forces as expressed in the diagram Fig. 10. Here the same machine is shown with the armature in two positions differing by 90 degrees, the first is a position of maximum effort, while the second is a minimum as the field poles are changing to the opposite designation indicated by the lower letters. As the machines are provided with fly wheels of considerable weight, the point of maximum effort shown in the upper diagram is the one at which the machines most readily come into synchronism with each other, being the point of least opposed mechanical resistance. In Fig. 5 is shown the simplest adaptation of the synchronizing device to a system of telegraphic transmission. The motors X and Y are connected to the line M L, as shown in Fig. 2. The synchronizing curren





FIGS. 6, 8 AND 10.—A NEW SYSTEM OF MULTIPLEX TELEGRAPHY.

armature pole is therefore made to follow a changing field that moves through 180 degrees at each reversal of the current.

Fig. 3b illustrates an experiment made in determining a suitable form of armature. A two-point key was used to reverse the field intermittently, the armature being supplied with an independent direct current. Even with this irregular alternation of the current the motion was still continuous. Another method of preserving absolutely steady synchronism is shown in the sketch Fig. 8. It consists in providing the driven machine with a single coil armature and a multipolar field; thus arranged the armature passes through a smaller arc of the entire circle at each reversal of the field; but while the motion is steady it has the evident disadvantage that so high a speed cannot be obtained with the same number of reversals in a given time.

Such are the main features of the synchronizing device. There are numerous details which cannot be treated within the limits of

duction coil and a key being connected in this line, the secondary of the coil was connected, as shown, to an ordinary telephone receiver. If the machines were moving in unison, the circuit of the primary would be completed whenever the revolving trailers were simultaneously upon the connected segments in the two machines, and the key was closed. If either trailer were slightly in advance of, or behind, the other there could be no primary circuit formed on closing the key, no induced current, and no sound in the telephone. The machines were driven at variable speeds, and the wire at one machine was moved from one segment to another until the particular one was found that corresponded to the one selected in the first machine; the telephone then responded accurately to every revolution, thus proving the synchronism perfect within less than the breadth of a single segment. Other wires were then connected to other segments with a like effect.

is constantly maintained upon the line and is made to serve also for transmission of signals. It will also be observed that as the armature of the relay at X puts opposite halves of the line battery to earth alternately at each half revolution of the machine at X, one-half of the circumference of the segmental distributor corresponds to the transmission of positive and the other to the transmission of negative currents to line. Thus while the trailer is sweeping over one-half of the distributor one part of the line battery L B is connected to line and earth, and while traversing the other half of the distributor the other part of the battery will be in circuit, each in turn sending a succession of impulses of opposite polarity. Some arbitrary line as Q^1 U^1, may therefore be drawn diametrically across the distributor at X and on one side of this line positive, and on the other negative, currents will be sent to the line wire, and by making the distributors movable about its axis the line Q^1 U^1 may be made to fall

within the broad spaces $E+$ $E-$. The distributor is composed of two parts one designated $E+$, and $E-$ is connected directly to earth; the other consists of a series of insulated segments 1, 2, 3, etc., in opposite quadrants of the distributor. Whenever the trailor is on the part $E+$, $E-$, the battery has a free path to earth and line through the trailer Tr^1. The insulated segments are connected to the local branches in pairs, each local branch having at least two such segments diametrically placed in opposite halves of the distributor. The connections and instruments in circuit are alike for all the branches and are therefore shown in detail for only one.

Each branch—say that of operator No. 5—has a double line to earth taken from opposite halves of the distributor as those shown at 5 + and 5 —. These branches are connected to a three point switch W^1 and W^2, which may be turned to R^1 and R^2 for receiving, or to S^1 and S^2 for sending, thus throwing the key in circuit, or Sy^1 and Sy^2 for synchronizing, thus leaving the sending and receiving apparatus out of circuit. An ordinary reversing key is used, the relay circuit being connected to its middle point. The drawing represents station X sending and Y receiving. Thus, if the key be depressed, as at Y, so that its front contact puts the line to earth, intermittent pulsations of one polarity will go to line, corresponding to the contacts made by the trailer with the segment pertaining to this branch on the right hand side of the distributor at X, while the negative currents, corresponding to the left hand half of the distributor, will be cut out, and the corresponding relay at both stations will be actuated by currents of constant polarity. If, now, the key be reversed, the trailer, on reaching the opposite segment, 5—, will send an opposite current to line and earth, causing the polarized relay to reverse in accordance with the motions at the key; hence signaling may be effected with a sounder connected in a local circuit as shown. Thus, if the key were closed at both the front and back contacts at the same time, the receiving relays would all vibrate in unison with the synchronizing relay in the line circuit and transmission is effected by cutting out all the positive or all the negative impulses, according to the position of the key, whether on its front or back contact. With a slow speed the contacts connecting any branch to the main line must of course be increased to insure certainty of action; but with a sufficiently high speed few contacts will be required. In the foregoing system, the synchronizing current which is only used as such at two points during each revolution, is made to answer for signaling purposes also.

There are of course numerous details incident to such a system that cannot be dealt with in a superficial description. Each operator's circuit being made up of a number of rapid contacts with the main line, each one of the ordinary Morse characters is necessarily made up of a number of pulsations of current, and the serious problem has been to construct a relay that would respond to these broken currents. A single polarized relay has a tendency to leave its contact during the breaks. A number of devices have been made to correct this. Fig. 6 shows by a diagram of circuits a modification of the system of single wire transmission in which superposed currents of high tension are used to actuate receiving apparatus, thus making them independent of the synchronizing current. The key is so arranged as to open and close the primary of an induction coil, the secondary of which is connected to line. A telephone or similar receiving apparatus arranged to respond to currents of high E. M. F. is connected with a receiving circuit instead of the relays. With such a system of transmission a higher order of multiplex transmission can be obtained than with ordinary receiving apparatus, and it requires so little current to actuate these instruments that each operator can work a circuit with a far less number of segments. As the trailer makes contact with any particular segment there will be of course two currents sent, due to the make and the break. In Fig. 7 is shown an arrangement by which the first of these is cut out. The primary of the induction coil connected through a separate trailer and series of segments is closed by the key before the trailer connected to the line circuit has reached its segment. The induced current due to the break only is then transmitted to line. This device is shown in Fig. 7, and as there indicated it has also been made to work polarized relays suitably wound for these high tension currents.

The general subject as a system of telegraphy will be recognized as a rather extensive one for a single paper. I have given the details of a few of the more decisive experiments that have been made, and I have confined the paper to what has actually been accomplished. With reference to practical results on a line test I shall have more to say at a later day. A technical paper, at its best, is uninteresting, and the present one is already long. In closing, I will answer a pertinent question that may occur to many: Of what use is a system of multiplex telegraphy?

The answer is this: We live in an age of industrial advancement. People are no longer satisfied with what is good enough. They want the best. The best rail for roads must be made of steel, and, this fact once established, iron was no longer suited to the requirements of travel, and iron roads have been turned into steel ones. The steel rails bears the same relation to iron in the systems of transportation that the copper wire does to the iron one in systems of telegraphic communication, the higher rate and more reliable service required demanding already in a large degree the substitution of copper for iron wires on the main lines of business. With a good copper wire and a reliable system of multiplex transmission, a single wire from New York to our principal cities would meet all the requirements of business, and it is no exaggeration to say that with these conditions given the existing system of intercommunication by the telegraph could be duplicated at a cost of one-tenth the present amount of capital invested by either the government or private enterprises. That is what copper wire and multiplex telegraphy mean, and it is doubtless the reason why so many find the subject worthy of their best endeavors.

The Edison Convention at Kansas City.

[By Special Dispatch from our Regular Correspondent.]

KANSAS CITY, Feb. 12, 1889.

The Association of Edison Illuminating Companies began its ninth annual session at the Coates Hotel this morning, with a full attendance. Among those present are: F. Oswald, New Orleans; John I. Beggs, New York; C. J. Field, Brooklyn; J. H. Vail, New York; J. H. McClement, New York; A. H. Reece, St. Louis; J. R. Skehan, New York; W. Preston Ogg, New York; F. E. Jackson, Newark; Thomas P. Merritt, Reading, Pa.; C. E. Chinnock, New York; E. H. Brooks, Lebanon, Pa.; H. McL. Harding, New York; J. M. Schenk, Lebanon, Pa.; James F. Kelly, New York; C. L. Edgar, Boston; L. Stieringer, New York; G. F. Parmelee, Topeka; W. J. Jenks, New York; J. W. Godfrey, New York; F. W. Armour, New York; W. W. King, Topeka; H. L. Lufkin, New York; R. M. Jones, Laramie, W. T.; Leigh Carroll, Birmingham, Ala.; A. Ledyard Smith, Appleton, Wis.; J. R. Markle, Detroit; H. Ward Leonard, Chicago; F. A. Copeland, Lacrosse, Wis.; M. E. Baird, Windsor, Ontario; William D. Kurz, Lacrosse, Wis. Before the convention met, the delegates, under the escort of Messrs. Grimes and Weeks, of the Kansas City Edison Electric Light and Power Company, rode to different parts of the city on the cable cars. Mr. John I. Beggs, president of the association, and vice-president of the Edison Illuminating Company, of New York, called the delegates to order. Mr. J. H. Vail, General Superintendent of the parent Edison Company, of New York, acted as secretary. Mr. George W. Lee, president of the Common Council, in the absence of Mayor Kumpf, extended a welcome to the delegates. "Kansas City," he said, "is always glad to welcome any body of men who are banded together for advancement of any enterprise—scientific, agricultural, or whatever it may be. Especially are we glad to welcome you who are seeking more light. I tender you the freedom of the city, and hope your stay will be pleasant and profitable." President Beggs said: "I extend to you the hearty thanks of the Edison Association for the cordial welcome you have extended it. It is one of our cardinal principles that the moment we enter a city we make ourselves solid with the chief of police, and then we have done." (Laughter.) President Beggs then introduced John L. Peak, of this city. He said he had been called upon at a few moments' notice to make an address. "I bid you a hearty welcome to our city. We may not have as magnificent structures, as palatial residences, or as expansive parks as you have been used to in the East, but you must remember that less than thirty years ago this city was a little straggling hamlet, contented to be known as Westport Landing. Now you can see by our electric wires overhead and by cables underground that we have made wonderful progress. We, of Kansas City, never sing our own praises, we are modest, we let visitors—our friends and our enemies—do that. Still we point to many of our material improvements with pride. A marvel of Western enterprise. Better and higher than all this, we have our poets and poetesses, our authors and authoresses, who are widely read. We can point with pride to our newspapers that are the equals of any printed in the East. Nor is the name of Edison unknown to us nor his wonderful inventions, the telephone, the electric motor and light, and perhaps the greatest of all, the phonograph, that will permit our descendants 500 years from now to hear our voice as it is to-day; to hear the songs we sing, the words we speak, until we wonder where the inventive genius of this wonderful man Edison will end. I think there will be a time when the air will be plowed with electric ships and the moon will be to us as the Samoan Islands, only a coaling station on the Celestial voyage. I again welcome you to our city, our homes and our hearts." The speech was followed by uproarious applause. President Beggs responded, and said that the treatment of all the guests since their arrival, had been all that could be desired. They had been given a cable ride and a pleasant time.

The meeting was formally opened by the presentation of credentials. Then followed the reading of the minutes of the last meeting held at Nantasket Beach, near Boston. The first paper on the programme was on Incandescent Lamps by Mr. Edison, read by the secretary of the Convention, and a warm discussion followed, which sounded the keynote of the Convention. In the afternoon, W. J. Jenks, of New York, led in the discussion of the subject of Meters, which was followed by a paper by Mr. J. H. McClemen reviewing the Edison patent suits. This is the main subject of interest to the Convention, attracted great attention, and stirred up a lively discussion.

The evening session was made public, and was devoted to the illustration and explanation of the progress and present development of Edison ideas and appliances in electricity. This was done by the throwing of views on a screen with a sciopticon. Among the views given was one of the *Grand Trunk Herald*, the paper edited and published by the youthful Edison; another of Menlo Park; photographs taken by electric light; the oldest forms of incandescent carbons; Edison's laboratory; the first carbonizing furnace; the original forms of the vacuum pump; Edison's first electric generator, the old Edison lamp factory; several views of the Edison plant at Appleton, Wis.; a number of views of the Edison plant at Santiago, South America; THE ELECTRICAL WORLD'S illustrations of the Edison Central Station in Milan, Italy, and of the various Edison stations in New York City; the fundamental Edison patents and systems of wiring.

KANSAS CITY, Mo., Feb. 13, 1889.—A number of new arrivals graced the second day of the Convention among them being Mr. E. Wildes of the Topeka, Kan., Edison Company and J. G. White of the Kearney, Neb., Company. The first topic brought to the attention of the delegates was that of the best methods of introducing the light of new stations and kindred subjects connected with stations newly installed. Following this discussion the Convention took up the question of free wiring, whether it was a good policy and one that should be carried out invariably. The best methods of settling the capacity of a station were presented and elicited a number of practical talks of great value. One of the most interesting and most valuable papers of the Convention was that of Prof. William D. Marks. Professor of Dynamic Electricity and Steam Engineering in the State University of Pennsylvania, and Superintending Engineer of the Edison Electric Light Company, of Philadelphia. The subject was "The Steam Engine." He spoke of the respective merits of high pressure compound and condensing engines. The paper was warmly received and was given detailed attention. Mr. J. H. Vail followed with a very able paper, discussing the question of the sale of the electric current by the Edison stations, for the use of electric railway systems. Mr. W. J. Jenks read a paper on the inspection of central stations, and also one on insurance. Mr. Parsell, of the Sprague Electric Motor Company, read a paper on the use and value of the electrical current for special purposes. This closed the papers, and, after a discussion of general subjects, the convention adjourned. That the convention was a success, the good feeling and lively conversation among the delegates when outside the convention door gave most palpable evidence, which was corroborated fully and emphatically by the delegates themselves, who pronounced it the most successful and the most enjoyable convention ever held. All the delegates from the Edison companies reported a most gratifying increase in earnings; some that had not heretofore been able to earn a dividend having now reached that prosperous period, and with prospects for paying an increased dividend this year. From floating bits of conversation and private and limited "tips," it is known that the great question up before the Convention was that of patents. The delegates agreed that the fundamental Edison patents were *the* patents, and were unable to see any possibilities of court or jury ever overthrowing one of them. All were full of the Bate decision, and claimed that as simply a presage of the final and overwhelming victory to be gained by the Edison companies. The question of what was the strongest point for Edison was also discussed, and on this there was much disagreement. The question of joining the National Electric Light Association was also discussed, and it was decided not to join. This decision met with some timid opposition on the part of Western stations. The reason assigned for the refusal to unite with the National Association was that the Edison ideas would be seized upon by the competing companies and used to the disadvantage and great damage of the Edison companies. The Convention as a body and the delegates as individuals, and Mr. Vail, the courteous and efficient secretary, in particular, have asked that special mention be made of their treatment here at the hands of the Kansas City Electric Light and Power Company, as represented by Mr. W. B. Grimes and Mr. E. R. Weeks. These two gentlemen and other representatives of the company have, by means of cable rides, visits to the packing-houses, the leading banking institutions, the stock yards, trips over the elevated railway and to all points of interest and importance in the city and vicinity, and by visits to the theatres in the evening kept the whole convention amused and interested during every leisure moment. Among the exhibitors of supply companies who were on hand during the Convention was Mr. James W. Godfrey, the energetic general manager of the New York Insulated Wire Company. He had on exhibition a full line of Grimshaw's patent "white core" wire and tapes. This wire is being placed in the big New York Life Insurance Company's building now in course of construction in this city. The same wire is also being put in the same buildings in Omaha, Montreal and St. Paul. Mr. Charles R. Truex, assistant general manager of the Electrical Accumulator Company, of New York, and Mr. Z. Latshaw, representing the same company, were also here, but their exhibit had been here for some time prior to their arrival. It was the Central and sub-stations of the Inter-state Electric Light Company. The delegates were shown through the various stations, and a thorough inspection of the plant was made. Mr. Robert T. Coleman, representing the Indurated Fibre Company, of New York, was present, but made no exhibit, as was also Mr. George T. Manson, of the well-known Okonite Wire Company. Mr. F. E. Kinsman representing the Electrical Construction and Supply Company, of New York, had a simple lamp on exhibition. M. E. Baird, representing the Eddy Motor Company, of New York, had one of his motors here and made a most gratifying success in the display of it, securing orders for quite a number of them. Upon the adjournment of the Convention the majority of the delegates left for their homes, but some of them went to Chicago, where the Electrical Exhibition will be held, beginning on the 19th. Some of the delegates are still in the city, but none, it is safe to say, will be here by to-morrow night.

K. C. M.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, Feb. 18, 1889.

Indurated Fibre Conduits and insulation are to be represented at the Chicago Convention by Mr. Coleman, of the H. W. Johns Company, which now controls that specialty.

Mr. E. A. Leslie has resigned from the Consolidated Subway Company and has accepted a position as manager of the Manhattan Electric Light Company of this city, whose work is now in an advanced state.

The Electrical Accumulator Company.—Mr. C. A. Truex, of this company, has been attending the Edison Convention at Kansas City and goes thence to the other convention at Chicago. He will also look up the growing interests of the company in other parts of the West.

The E. P. Gleason Manufacturing Company, of this city, will be well represented at Chicago by Mr. Gennert, who has now attended so many of the meetings that he is regarded as one of the "stand-bys." The company have been doing extremely well with all their fixtures and specialties for the electric trade.

Mr. W. H. Cole, of 502 West Fifty-third street, has been the consulting engineer for the Sing Sing Electric Light Company, which has put in a Westinghouse alternating plant of 1,500 lights. He is also putting in a plant for the Long Point Hotel, Seneca Lake. He gives special attention to testing and expert work, having a full set of the most approved laboratory apparatus.

Belting Interests.—Messrs. E. Gabel and F. W. Baugher will represent Charles A. Schieren & Co., 45 and 47 Ferry street, makers of the "Electric" belt, at the Chicago convention. Mr. E. L. Burrell will represent the American Leather Link Belt there with a large exhibit, and Mr. C. A. Schieren, Jr., will attend the convention in the interests of leather tanning and manufacturing, for all purposes.

The Ball Electric Light Company, of 18 Cortlandt street, whose fine factory recently formed the subject of an interesting illustrated article in a popular style in the *Scientific American*, find themselves heavily taxed to meet the demands for their dynamos and lamps for incandescent lighting. The list of plants that they have installed is already a long one, but the business of the present year bids fair to equal all that has been done up to date, old and well-known as the system is.

Messrs. Woodbridge & Turner, 17 Cedar street, contractors and erectors of electric light plants, electric railroads, etc., have been installing a number of plants since their organization about one year ago, including the electric railroads at Salem, Mass., and Hartford, Conn., as well as that at Reading, Pa., illustrated by you last week. They were also sub-contractors on the West End Road, Boston. They have just closed a contract for the Sprague electric road at Chattanooga, Tenn., which will be one of the finest plants in all the South.

Manning Vertical Boilers.—It is appropriate that I should call attention to the Manning vertical boilers, as manufactured by C. R. Vincent & Co., of 15 Cortlandt street, who have a special license to manufacture and install these boilers, as part of their large business in connection with the estimation and construction of complete steam plants for arc and incandescent lighting and electric railroads. They are also selling agents for the Ball automatic high-speed engine, the Reynolds-Corliss engine and the Skinner engine, as well as for a general line of boilers and steam appliances.

The Imhauser Pole Indicator.—My attention has more than once been arrested by the merits of the Imhauser pole indicator, sold by E. Imhauser, of 206 Broadway. Some time last fall, in company with Mr. Peter Klaus, now general manager of the Continental Dynamo Company, I took one of these instruments into the sub-station of the United States Illuminating Company, on Fulton street. There Mr. Bennett, the superintendent, connected it up in a 110 volt circuit, and it immediately indicated the direction of the current. I have also seen the same instrument indicate readily on one cell of Roberts-Brevoort dry battery. The great advantage, of such a handy appliance to test polarity of current at any point in a fire alarm, district messenger, telegraph, annunciator, lighting or other circuit, is at once apparent—whether the current is on or off. The instrument, too, is portable, and does not bulge the vest pocket any more than an ordinary watch.

Ornamental Lighting Fixtures.—Mr. A. T. Enos, of Oxley, Giddings & Enos, 224-226 Canal street, did me the kindness to show me last week a beautiful newel post "electrolier," designed and made specially for the fine new offices of the Thomson-Houston Electric Company in Boston. It is a handsome column in embossed and répoussé work, around which coils a grim dragon coated in scaly armor. The head of the fabled monster is brought to one side of the column, and from his ugly jaws protrudes his forked tongue, forming the conductor for three incandescent lamps. At the top of the column are antique holders for three more lamps. The whole is finished in gold bronze and wrought finish, and done with the artistic taste and refinement of detail for which the firm is so noted. In fact, if any of your electric light readers are ever in New York, with leisure to be profitably used, I would recommend a call at the showrooms of the firm, whose productions I consider far superior to anything I ever saw imported from Europe.

Tarrytown Heights, N. Y.—Mr. C. A. Benton is blithe and complacent over recent large orders for Edison apparatus for the nabobs of Tarrytown Heights. He has recently, with the assistance of Greenfield & Co., been wiring the new and beautiful home there Mr. T. C. Eastman, the millionaire dressed beef exporter. The house, stables, etc., have been wired for 250 lamps of 16 c. p. with Habirshaw India rubber and gutta percha covered wire, porcelain insulators, and all the other most approved appliances of the Edison system. Some novel special pieces are talked of for the lawn and grounds. Mr. Eastman has supplemented this order by a second one for a complete Edison plant to go in his big abattoir, Fifty-ninth street and Eleventh avenue, aggregating between 500 and 600 lamps of 16 c. p. The Gerlach plant that I spoke of last week, of 1,000 Edison lights, was also sold by Mr. Benton, who has also, I may add just closed another contract at Tarrytown, where, as well as at Irvington, he seems to have set what may well be called the "electric light fashion."

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, 146 Franklin St. and 149 Congress St.
BOSTON, Feb. 18, 1889.

Ashton Valves.—Mr. Charles H. Buckelew, for many years in the employ of the U. S. Government as a steamboat inspector, has been appointed manager of the New York branch office of the Ashton Valve Company, with offices at No. 92 Liberty Street.

The Wright Engineering Company.—Mr. Alex P. Wright, who has recently settled amongst us in Boston, is already doing a considerable amount of expert work in connection with the planning of new electric light stations and the reconstruction of old ones.

The International Telephone Company is sending to Caracas, Venezuela, S. A., a new multiple switch-board (Western Electric make) for use in the telephone exchange established in the city named about one year ago. It is gratifying to learn that the exchange referred to has at the present time about one thousand subscribers.

The Tropical American Telephone Company.—In addition to supplying its sub-companies and agencies in South and Central America with all the requisite apparatus for conducting first-class telephone exchanges, the company has established, and is now fitting up, new exchanges at Antigua, St. Kitts, and St. Lucia, in the West Indies.

Spencer Damper Regulators.—Mr. G. G. Stillman, of Boston, the New England agent of this popular regulator, announces the following sales during the past three months: Auburn E. L. Company, Auburn, N. Y.; Naugatuck E. L. Company, Naugatuck, Conn.; West End St. R. R., Boston, Mass.; J. H. Conant & Co., Watertown, Mass.; Stanley Manufacturing Company, Lawrence, Mass.; Hotel Tudor, Boston, Mass.; Electric Light Company, Narragansett Pier. R. I.

Electrics at New Bedford.—The Westinghouse Electric Company, through its Boston agency, has sold a 1,500-light incandescent plant (alternating system) to the New Bedford (Mass.) Gas light Company. This first-named company is having a heavy run on its new meter, there being a constant demand for this valuable and useful device among local electric light companies using any alternating system. Sixteen of these were sold recently to the Gardiner, Mass., Electric Light Company.

The New Storage Battery.—The Johnson Electric Supply Company, manufacturers of the Johnson storage battery, are now nicely settled in their new quarters, No. 12 Mt. Washington avenue, Boston. Special machinery has been built for the manufacture of the new accumulator, which is of peculiar pattern and construction, yet perfectly adapted to the purposes intended. Mr. Geo. A. Johnson is the inventor not only of the new storage battery but also of the special machinery referred to.

The Samson Open Circuit Battery.—This remarkable battery is working its way into public favor and into general use wherever a good product of its kind is needed. Those who have used it in this section are highly pleased with the results obtained and continue their purchases. Manager Burnham, of the Electric Gas Lighting Company, of Boston, who first introduced that meritorious open circuit battery in this country about nine months ago, says: "There are to-day nearly five hundred different concerns or individuals using the Samson battery for various purposes, and not a single complaint has yet been heard."

Personal.—Mr. H. H. Elkins has severed his connection with the American Electric Manufacturing Company, and is now a resident of Boston and engaged in experimental work on improvements in electrical and electric light apparatus.

Mr. F. E. Pettingell, of the well-known Boston electrical supply firm, Pettingell, Andrews & Co., started on a Western trip in the interest of his house early last week. He will visit—among other cities and towns in the West—Cleveland, Detroit and Chicago.

Mr. James P. McQuaide, secretary and treasurer of the National Conduit Manufacturing Company, of New York, visited the "Hub" on a business trip early last week. During Mr. McQuaide's stay in Boston he was a guest at the rooms of the Electric Club, and a sincere welcome greeted him at every electrical establishment he visited.

Rival Electric Light Companies.—New complications have arisen at Dedham, Mass., in the contest for the business of electric lighting. The Dedham & Hyde Park Gas and Electric Light Company, which has started a plant in Phœnix block, with exhibition lights hung from the building, and which has a clearer field, now that the attempt of the Dedham Water Company to obtain legislative sanction to enter the business has failed, was ordered Tuesday afternoon to stop the running of its plant by the owners of the building, because the insurance companies issuing the policies thereupon have adjudged the arrangement of wires unsafe. The Dedham Electrical Company is the third that has sought the business, and, though yet unorganized, it is believed its promoters are seeking to establish it and compete for the business. The matter is exciting much local attention. W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 City Trust Building, Philadelphia, Pa., Feb. 16, 1889.

The Large Mill of Hetzel & Co., on Washington avenue, is to be lighted with 400 incandescent lamps. The contract was awarded last Wednesday, and the National Electric Light and Power Company were the lucky bidders. They use the Cohen system.

The New Edison Central Station on Jansen street begins to have the appearance of a busy place. The dynamo room now has four 2,000-light machines in position and a like number of Armington & Sims engines have just been set up. Professor Marks expects to begin operations shortly and already has a force of competent men at work testing all buildings which have been wired for the current.

The Masonic Temple.—There is quite a contest over the awarding of the contract to light the Masonic Temple, at Broad and Filbert streets. All the local companies and agencies were invited to bid, and on Tuesday night, when the committee met, a motion to return all bids was adopted and proposals were again invited. About 800 lights will be placed in the building, and nothing but the best work is countenanced. The award will probably be made this week.

Horn, Brennan & Forsythe have just completed putting in the fixtures for the Cincinnati Board of Trade building. Some of the electroliers and combination fixtures are said to be as fine as anything ever gotten up for a like purpose, and the citizens of Porkopolis are delighted with the work. Mr. Brennan has also contracted to furnish the Chestnut Street National Bank, which has quarters in the new Singerly buildings on Chestnut street, with combination fixtures.

The Julien Electric Company's factory in Camden is turning out over 150 cells per day. Owing to their improved machinery the work of making the plates is greatly accelerated, while the cost is reduced greatly. Mr. Salom, one of the resident directors, says that he is perfectly satisfied with the action of the battery and its life and efficiency, but the aim of the company is to so reduce the cost as to make its adoption for driving traction motors and doing storage work an absolute necessity.

Messrs. Churchman & Co., chemicals, at No. 33 South Front street, report having a large demand for their specialty, chromic acid in powder, manufactured by Sullivan & Company, of London. They have received indorsements from eminent electricians, who, without an exception, pronounce it the best battery acid they have ever used. They particularly recommend its strength and cleanliness. Messrs. Churchman & Co. are the sole agents for this acid in the United States.

A Fire at Murray's.—The new main building of Messrs. James J. Murray & Co.'s glass works was destroyed by fire early Monday morning. The cause was directly attributed to the bursting of a large pot of molten glass, which quickly ignited the woodwork and speedily reduced the whole structure to ashes. The loss was about $10,000. Mr. Murray intends to rebuild the structure immediately, and will resume work in a short time. In the meanwhile all unfinished orders will be filled by special arrangement, and there will be no interference with the business.

The Eastern State Penitentiary is to be lit throughout with electric lights. The plant, which is now being installed, will consist of three 500-light incandescent dynamos, and one 50-light arc machine. These are designed and manufactured by C. R. Donald & Co., and are self-regulating to one-half of one per cent., from a full load to an open circuit. About 30 arc lamps will be distributed throughout the grounds now, and the buildings will be illuminated by 1,250 Sawyer-Man lamps, one being placed in each cell, controlled by a circuit switch. Additional lamps will be placed in when needed.

Messrs. Walker, Keppler & Co., the Philadelphia agents of the Edison Company, have lately completed some large contracts for isolated plants. The most recent installation was that placed in the sugar refinery of Harrison, Frazier & Co., for 2,700 16 c. p. lights. They also wired the building. The wiring of the Repper building at Sixth and Minor streets was also done by this firm, who put 672 lamps in position, waiting for current from the Edison central station. One of their masterpieces, and to which Mr. Walker naturally never tires of referring, was the plant put in the Drexel building, which is certainly a model in all respects.

Wm. Cramp, Son & Co.—It was my pleasure to be shown through the shipyard of Wm. Cramp, Son & Co. one day last week, and nothing proved of greater interest than the electrical arrangements now being placed on the future ships of war. The gunboat "Yorktown," which had her first trial trip last week, was fitted up temporarily with a 200 light Edison dynamo and a small high-speed engine. This vessel is in the hands of the United Edison Company, which has contracted to place two 150 light machines and an Armington & Sims engine on board. The vessel has been wired throughout by the same company represented by Mr. F. Craig. The remaining gunboats and also those now being built at Chester, Pa., will be furnished with electric lights plants by the United Edison Company. The work is officially inspected by Lieut. S. Veeder, who was recently detailed for this duty by Secretay Whitney. E. F. C.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, Feb. 16, 1889.

The Pumpelly Storage-Battery Company are putting a new battery on the market, and have just opened with elegant offices on La Salle street, Chicago, under Grand Pacific Hotel.

Elgin, Ill.—The city of Elgin has just purchased for its use the Van Depoele plant formerly operated by the Elgin Electric Light Company, of which Mr. Geo. Bowen was the chief stockholder. It is understood that the tower mast system will be retained and improvements made.

The Southern Electrical Supply Company has been organized in St. Louis under auspicious circumstances and with the best wishes of friends. The new company carry a complete stock of everything desirable in the line of electrical supplies. They are agents of the Okonite wires and cables, the demand for which has grown to enormous proportions. Walter C. McKinlock, formerly with the Central Electric Company, is the secretary of the new firm.

Truxillo, Honduras, Central America.—The Guyape Mining Company, of Truxillo, Honduras, has just purchased of the Van Depoele Electric Manufacturing Company a number of arc and incandescent machines for use in their mines. The machines are to be made in sections, each section not to exceed 125 lbs. in weight. They are so constructed to enable them to be transported across the mountains on "burro trains."

The Baxter Motor in the West.—The application of the motor in the West is rapidly gaining ground. The progress made in Chicago alone is most satisfactory, when it is considered that it is only about a year since the first motor was introduced for driving machinery. The honor, I learn, of turning the current on to the first motor to be used for running general machinery is due to Mr. W. W. Monroe, the Western Manager of the Baxter Company. This machinery consisted of five Gordon printing-presses and a cutter. Since that time many other printers have employed the motor for the same purpose.

Incandescent and Arc Light Switches.—I learn that the Central Electric Company have just arranged for the important exclusive agency of the Cleveland incandescent and arc light switches. Their territory covers everything west of the Mississippi River and the states of Illinois, Michigan, Wisconsin, and Minnesota. The company also have the agency of the Manson tape made by the Okonite Company. The tape is put up in boxes and is made both in white and black. It is needless to say that it is fully up to the standard of that company's well known products.

Heisler on the Pacific Coast.—The Heisler Electric Light Company, of St. Louis, writes as follows: "The Heisler system on the Pacific Coast, at Portland, Ore., has made a glorious fight with the gas company of that city and obtained the contract for 125 30-c. p. street lamps. The circuits are twelve miles in length, using No. 8 B. & S. American gauge weatherproof wire, and it has been stated by local papers that the lights are very satisfactory to the council and citizens. The plant and circuits will be enlarged and extended by Mr. H. A. Hogue, proprietor of the central station, so as to enable him to furnish commercial and private house lighting. This makes six large central station plants of the Heisler system on the Pacific Coast, most of them furnishing street, commercial and private house lighting from one central station plant on very extended circuits."

Kearney, Neb.—The Western Engineering Company, formerly of Lincoln, Neb., removed to Kearney some time since. The change was made to gain larger facilities in transacting the business of the company, which is rapidly increasing. With the change of location the company has added largely to its paid-up capital, so that it is now in good shape to handle business in the future. The company has recently started isolated incandescent plants at the County Court House, St. Joseph, Mo.; Institution for Deaf and Dumb, at Council Bluffs, Iowa; mill of Lincoln Paper Company, Lincoln, Neb., all of the Mather system. They have also started central stations at Red Cloud and Beatrice, Neb. At the latter place a 650 light plant was installed and payments received within a month from the signing of the contract. At Council Bluffs, Iowa, the company is now at work on a 2,000 light Westinghouse plant which will soon be running. The company is also putting in a clay tramway, Sprague system, for the Kearney Brick Company, Kearney, Neb.

The New Sperry Catalogue.—I am indebted to the Sperry Electric Company, Chicago, for a copy of their new catalogue, which is both handsome and readable. It is somewhat unique in design and of convenient size for the pocket. In it are set forth some of the claims made for the superiority of the Sperry apparatus, and it contains strong testimonials from among a large number of the patrons of the system. There is something of a radical departure in the circular from the usual printed matter generally circulated, that assures for it a welcome reception, inasmuch as considerable data is given for the benefit of the prospective purchaser relative to the cost of his circuit if he contemplates constructing it himself. One page of the circular contains a list of the tools required in constructing a circuit, with cost of the same. On another is found the quantity and cost of material and supplies required in installing a five-mile circuit having 20 lamps for commercial purposes, and 20 for city lighting; while a third page is filled with hints regarding the construction work and estimates on the same.

How Rawhide Dynamo Belting is Made.—It is interesting to note the progress in every line of manufacture. In no branch is the development probably more marked or complete than in the electrical field. The lamp and dynamo of to-day are finished products compared with those of a short time ago, and still the improvement goes on. The successful operation of every electrical plant is dependent upon its equipment throughout. To have the desired efficiency and economy it is all important that not only the electrical but the non-electrical apparatus be of the best material and workmanship, and constructed with special reference to the work to be done. The engine, the belt, the furnace and the boilers each have special claims for consideration as to their size, capacity and durability. In the manufacture of the apparatus mentioned it is encouraging to note the efforts at present being put forth by the manufacturers to place on the market the best goods that experience can produce. While among this class of manufactured articles, a large number could be mentioned, the little space I may devote at this time to the subject of the manufacture of belting for dynamo purposes, will I trust, be found of interest to your readers.

The Chicago Rawhide Manufacturing Company, of this city, enjoy the distinction of being the only manufacturers of rawhide goods in the country. Their factory, located on Ohio street, is a large commodious five story building occupying 50 × 100 feet ground space, and was established eleven years ago, its products being at present found in nearly every country on the globe.

Your correspondent, availing himself of a courteous invitation from the genial secretary and treasurer of the company, W. H. Preble, was recently given an opportunity of inspecting the factory and methods employed in the manufacture of these goods. From the offices, which are located on the first floor, I was first shown to the basement by Mr. Preble, where it was explained all the "wet work" is done. Here the hides are received in their raw state, being selected before reaching the factory with special reference to thickness, and exclusively from steer hides—all natives, which are claimed to be superior to any other class of hides, those of cows being excluded entirely. The entire basement is devoted to the preparation of the hides to be used for belting, there being some ten patents employed in the different processes to which the hides are subjected before the belt is turned out in its finished state. The detail of these processes, of course, are known only to the manufacturer, but I gathered this much, that the hides are as nearly natural as can be got, no lime or acid being employed in any way to injure the hide. After being treated in this way, the hides are then taken to the top floor, which is used entirely for drying purposes. Here they are permitted to dry, still retaining their natural color, after which they are made into leather by purely mechanical methods. As soon as sufficiently dry, the hide is moistened, then stretched and the "stuffing" worked into it, the object of these manipulations being to preserve the leather and at the same time render it soft and pliable. The stuffing used, I may say, is composed of neat's foot oil and such substances as are natural to the hide. After this, the hide is cut up and finished for belting, the "butt" being the only part used for this purpose. This "butt," I may explain, is the portion left after cutting off the shoulder and belly. In the manufacture of dynamo belts it was explained that the "butt" is cut 6 inches shorter than in the ordinary manufacture, which is equal to ten per cent. in the value of the belt. From the drying room the butt is taken to the floor below where it is cut up with reference to length and then subjected to a process by means of which the stretch is taken out; after which it is again cut into the width required for the belt and again stretched; then trimmed by a special machine in order to make the sides entirely straight. By this time the stretch is pretty thoroughly taken out, though leaving sufficient elasticity. The ends of the pieces are then prepared for putting together by a machine for that purpose, being finished by a hand process. After this the pieces are thoroughly dried and then selected again, after which they are put together and cemented under heavy pressure, some six presses being employed on this floor for that purpose. The single belts made here are all sewed with rawhide thongs, being, I am told, the only single belt made in this way by a manufacturer. By sewing in this way it is claimed that the belt is rendered better adapted for running over swift turning pulleys. The belt then goes through a rolling machine and is stretched again, by means of which it is put under more strain than is ever required in actual service, the object being to thoroughly test it; after which it is trimmed and finished. The double belt is made in much the same way, it being either sewed or riveted. The special dynamo belt, which Mr. Preble explained is a product of much study and experiment on the part of the firm, is made just like the double belt, except that it is not sewed or riveted and is made endless. Its claims for superior excellence are in its extreme pliability, and having, it is said, greater adhesive qualities than other materials used for belting purposes by one-third in the same width of belt. It can be washed also with soap and water without injury, and has great strength, pains being taken in every way to make it so that it will run straight and smooth. Great life is also claimed for it, there being belting, I am told, in operation at the present time which has been running for the past nine years, the leather being practicably indestructible with proper care. On this floor, also, the portions of leather not used in the flat belt are made up into other goods. The round rope belt, which is coming into use so extensively for power transmission, is manufactured. I was shown in process of construction for the new factory of the Western Electric Company in New York two round belts 1¼ inches in diameter, each 440 feet long, and two 1-inch belts, each being 940 feet long. Great efficiency is claimed for

this method of power transmission and the rawhide belt seems to "fill the bill" in every particular. A portion of the first floor, on which are also located the offices, is devoted to the manufacture of a variety of things, among which I may mention that of rawhide blocks, which are used extensively for the manufacture of gearing for electric street railways. These gearings are said to be more durable than steel and are noiseless. Here also the small round twist belts are made, some of which are as small as 1-32 of an inch in diameter, and are used for running small machines, the strength being very great. These belts are also well adapted for telephone magneto purposes. Skilled artisans, I may say, are employed in every department, and the output of goods from the entire factory is, I learn, in excess of any previous year. Just now the demand for dynamo belting is very active, and an increase in the working force it is thought will soon be necessary. E. L. P.

MILWAUKEE, Wis., Feb. 13, 1889.

Wauwatosa, Wis.—The electric light plant in the village of Wauwatosa, but recently completed, was totally destroyed by fire last Monday night, together with coal-sheds and adjoining out buildings. The loss is upwards of $11,000, insured.

Wausau, Wis.—The Electric Light system, placed in the extensive mills and factory of Curtis Bros. & Co. by the United States Electric Light Company, was tested to-day, and proved entirely satisfactory. Two hundred lamps light the factory, glazing department, salesroom and offices.

The Telephone.—At the annual meeting of the Wisconsin Telephone Company, held in this city, H. C. Payne was elected president, to succeed Prof. C. H. Haskins, who is now a resident of New York City. George Albee, of Chicago, was elected a director. Frank E. Parker continues to hold the office of State Superintendent. During the year past, the company has built 329 miles of new line. Extensive building is to be done the ensuing year.

THE TELEGRAPH.

Telegraphy in Canada.—Mr. Denison, one of the supporters of the present administration in the Dominion, moved last week, in the House of Commons at Ottawa, for a select committee to inquire into the desirability of government purchase of the telegraphs, but the motion was withdrawn.

THE TELEPHONE.

Pan-Electric Ledgers.—The court in Washington has ordered in the suit of J. H. Rogers against his associates in the Pan-Electric Company for an accounting and restoration of property, that if the missing books of the company are not produced by Feb. 14 a commission shall go to Memphis to see if they are in the possession of Col. Casey Young there.

The Hamilton Telephone Bill, by means of which it is proposed to reduce rates in New York State, is now in the hands of the Assembly Committee on General Laws, before whom the various companies affected have appeared to present the case against such legislation. In the opinion of the protestants, the passage of the law meant the withdrawal of telephone service from the city and State of New York.

THE ELECTRIC LIGHT.

Hamilton, O., is calling for bids on city lighting.

Mauch Chunk, Pa., is, it is said, to put in a plant.

Mt. Sterling, Ky., is to have a plant put in at an early date.

Easton, Md.—The Easton Gas Company is to add an electric light plant.

Sycamore, Ill., is subscribing to the stock of a local electric light company.

Seymour, Conn., where Day's Kerite factory is situated, will put in electric lights.

Mobile, Ala.—Mr. A. S. Lyons will buy an incandescent plant of from 30 to 60 lights.

Atlanta, Ga.—The local electric light company has just declared a dividend of 7 per cent.

Oneida, N. Y., has voted to raise $3,000 for electric lighting by a popular vote of 267 out of 317.

South Chester, Pa., is considering proposals for electric lighting from the Westinghouse Company.

Hulmeville, Eden and Langhorne, Pa., are to have a plant, for which $13,000 has already been subscribed.

St. Charles, Mo., has decided to adopt electricity for street lighting, and will shortly be in the field for making a contract.

Bowling Green, O., has a proposition under consideration from H. H. Hogue, of Fostoria, to furnish a plant of 30 arcs of 2,000 c. p. at $100 per lamp.

Huntington, W. Va., is making a contract with the Huntington Electric Lighting Company at $3,500 per year and $50 for every additional lamp, full 2,000 c. p.

Camden, Me.—It is proposed by J. Knight, J. D. Knight and others to incorporate the Camden and Rockport Electric Light Company, with a capital stock of $12,000.

Baton Rouge, La.—The Electric Light Company of New Orleans has secured the contract for lighting Baton Rouge with 20 arc lights of 2,000 c. p., at $1,800 a year for three years.

New Orleans, La.—The payment to the Louisiana Electric Light and Power Company, which uses the Fort Wayne Jenney system, for lighting the streets, is $140,180 for the current year.

The American Street Lighting Company, of Chicago, has been formed with a capital stock of $300,000, for street lighting and manufacturing; incorporators, E. W. Cook, H. Keeler and L. O. Gilliland.

Conshohocken, Pa., having a report of tests made by Mr. Carl Hering on the subject, insists that the Conshohocken Electric Light Company shall keep its street incandescents up to the 25 contract candle power.

Oskaloosa, Ia.—The Oskaloosa Gas and Electric Light Company has been formed, and has bought out the local gas company. The capital stock is $75,000. The directors are W. McDonald, C. P. Searle and J. H. Graham.

The Electrical Engineering and Construction Company, of Chicago, has been formed with a capital stock of $600,000 by M. E. Willard, D. Brinkman and A. A. Bliss, for the manufacture, sale, installation and operation of electric light and power plants.

Baltimore, Md.—The Charles Munson Belting Company, of South Canal Street, Chicago, have just completed a mammoth 3-ply leather belt weighing over 1,200 pounds and designed to run the Brush electric light station at Baltimore, Md. This belt is 40 inches in width.

Independence, Mo.—Mr. C. H. Malin, of Fort Scott, with other capitalists, has bought out the Independence Gas, Water and Electric Light companies. The electric light plant is to be moved and improved.

Superior, Wis.—The Superior and Duluth Electric Company of Superior, Wis., has mortgaged its plant, etc., to the Central Trust Company of New York, as trustee, to secure an issue of 1,000 bonds at $100 each. The money is to be used in extending and improving the plant.

Lowell, Mass.—At a meeting of the stockholders of the Middlesex Electric Light Company, at Portland, Me., last week, it was voted unanimously to instruct the directors to apply for a charter under the laws of the State of Massachusetts. There were eight thousand of the thirteen thousand shares represented at the meeting. No other business was transacted. The annual meeting is to be held in June.

Chico, Cal.—The Chico Gas Company have erected a new brick building in which to place their electric and steam outfit, and have made arrangements with Mr. W. C. Clark, the Pacific Coast agent, to furnish them with a Waterhouse plant for both arc and incandescent lighting, and for a Ball engine 12 × 12. Mr. G. W. Dorn is the superintendent, Mr. W. J. Costar secretary, and Mr. J. Day engineer.

Detroit, Mich.—Mr. Fred H. Whipple reports that at a meeting of the Detroit Board of Aldermen last week, the city charter was amended so as to allow the city to purchase the electric light plant over which he was figuring for them about a year or so ago. They have now to go to the Legislature to get the action sanctioned. This plant will be one of the largest in the country, and its cost is estimated to reach over $400,000.

Electric Light Building for Jersey City.—The Jersey City Electric Light Company purchased ground in Jersey City, near the hill, at Wayne and Montgomery streets, yesterday, and they will build a two-story building, 200 by 150 feet. When it is completed the company's lines will be extended and private residences will be lighted with incandescent lights. The new building is to be of brick. Work will be begun at once.

Electric Light Litigation.—A special dispatch from Pittsburgh, Pa., of Feb. 9, says: In the United States Circuit to-day the Consolidated Electric Light Company made a motion for a hearing in the suit against the McKeesport (Edison) Light Company upon the Sawyer-Man fibrous carbon patent, the testimony in which has been closed in the United States Circuit Court. The court continued the motion of the Consolidated Company until next Saturday, and permitted the Edison Company to serve a motion for delay to be heard at the same time as the complainant's motion for an early hearing.

Madison, Wis.—The Madison Electric Company's franchise was granted last April. It has a Thomson-Houston arc machine, and is operating 40 street lights of 1,200 c. p. till 12 o'clock at $90 per year, and 60 commercial lights at $7 till 10 o'clock and $8 till 12. It is also using an 800-light incandescent machine of the Fort Wayne Jenney system, and is now running over 300 of the lights. Forty-five thousand dollars has been invested in the plant, which also includes two Ide engines of 70 and 100 h. p. and two 100 h. p. boilers from the Phœnix Iron Works, Meadville, Pa. Mr. G. W. Gilman is the secretary and treasurer.

Mount Morris Station, New York.—Altogether one of the finest of the new electric light stations in New York City is that now being completed for the Mount Morris Electric Light Company by the Hill Clutch Works, on Greenwich and Van Dam streets. The equipment throughout is the best, and will now include 400 feet of 24-inch three-ply leather belting for main driving belts. The order for this large quantity was secured last week by Mr. J. H. Shay, of the Charles Munson Belting Company, of Chicago. Although the facilities of the belting company are already overtaxed, the belts will shortly be delivered, and Mr. Shay promises that they will be foremost among the attractive features of a new station that is intended in every way to illustrate the latest advances in central station construction and equipment.

Standard Underground Cables.—The cables now supplying current to the electric lights in Hoosac Tunnel were made by the Standard Underground Cable Company, and they are the first circuits which have been successfully maintained in the tunnel, although previous attempts were made with line wire and also with underground cables of other make, but all proved to be failures until these were used. Orders are coming in at a rate far exceeding expectations, both for Standard weatherproof line wire and for lead-covered cables, and particularly electric light cables. Of the line wire (which is a comparatively new departure), they are now shipping at the rate of three to five tons per day, and are unable to keep up with the orders, but are arranging to run their line wire department day and night. Of cable orders we might instance a large order from the Electrical Bureau of Philadelphia, No. 6 B. W. G. with 6-32 insulation, the lead cover being provided with saturated fibre to prevent chemical action on the lead; also an order for No. 6 B. & S. G. electric light cable from Detroit, and a large order for No. 4 B. & S. G. electric light cable, also protected by saturated braid, for use in New York subways, by the Manhattan Electric Light Company.

APPLICATIONS OF POWER.

Sterling, Ill.—It is said that the new electric road will be running in six months.

Bucksport, Me.—The cloth factory of Westcott & Grindle is to be run by electric power.

Camden, N. J.—It is now proposed to extend the new Sprague road for Camden to Palmyra and Riverton.

The Wooley Electric Company has established itself at Cambridge, O., to make sewing machines with an electric motor attachment.

Pittsfield, Mass.—The Pittsfield Carriage Company has been putting in electric motors to run its factory. Motors are already in use in the same busy town for manufacturing purposes.

Auburn, Me.—The Ara Cushman Co., Auburn, Me., which some time since had installed in its shoe factory a 15-horse power electric motor, has just added another of 10-horse, so satisfactory was the working of the first machine.

Electricity for the Navy.—The House Committee on Naval Affairs has under consideration a bill appropriating $150,000, to be expended by the Secretary of the Navy in testing the efficiency of electrical power as applied to marine architecture.

Fort Worth, Tex.—The new electric road for Fort Worth is to be of the Fisher-Rae system, and to be built by the Detroit Electrical Works. It will use overhead wires. It will have 10¼ miles of track, and will start with 10 cars by May. The cost is put at about $60,000. It will be the first electrical road in Texas, and the whole State is taking a lively interest in it.

Harnessing the Rhine.—An attempt is being made at Zurich and Basle to raise a sum of £400,000 for the formation of a company with the object of "harnessing" the Rhine. It is proposed to construct a canal 2½ miles long, and the water power which would thus be made available is estimated at 35,000 h. p. This would be distributed to different manufactories by electrical transmission.

"Turn On the Juice," is the phrase used by the men on the electric road in Boston for starting the cars. A very interesting description of the electric drivers, with a portrait group of 14 of them, is given by the Boston *Herald*, and they are evidently a fine set of men. They are unanimous in their praise of the new system. The conductors also like it, although they have a new duty in keeping an eye on the trolley.

Mt. Desert, Me.—It is stated that the Mt. Desert & Eastern Shore Land Company have granted the right of way to an electric railroad company, which wil run a line six or eight miles long on their property, greatly enhancing the value thereof. The bonds, it is understood, have been successfully placed, and if all goes well the road will be in full operation next season. This, with many other contemplated improvements, will make the locality a very desirable summer resort.

Kearney, Neb.—A special dispatch of Jan. 29 from Kearney says: Articles of incorporation were filed to-day for the Kearney Electric Railway Company. The incorporators are: G. W. Frank, H. D. Watson, John J. Bartlett, George A. Sherwood, R. L. Spencer, D. C. Jackson and C. M. Rice. Officers: George W. Frank, president; H. D. Watson, vice-president; George R. Sherwood, treasurer; C. M. Rice, secretary. The capital stock is $100,000. This road is to be built at once of standard gauge heavy rails, the cars to be lighted by electricity, and first-class in every respect. The road is to be a belt line. It will connect the Midway Hotel with the hotel on the lakes, the cars running between the two every twelve minutes. Connection will also be made with the Union Pacific and B. & M. railways.

PERSONALS.

Mr. E. H. Goff will, it is stated, establish a commercial journal to develop trade between this country and Latin America.

Mr. Gibson, the New York passenger agent of the Guion steamship line, "expects to see electricity entirely used to run steamships."

Mr. Elmer G. Willyoung, representing James W. Queen & Co., of Philadelphia, has been in New York for that concern the past week.

Mr. W. H. Allen, who has been acting as special agent for the Hartford Steam Boiler Inspection and Insurance Company, has been made assistant manager of the Northeastern department.

Prof. H. A. Rowland is to deliver an address on "Modern Views with respect to Electric Currents" at Johns Hopkins University, Baltimore, Md., on Commemoration Day, Friday, Feb. 22, 1889.

Mr. David M. Stone, the veteran editor of the New York *Journal of Commerce*, in speaking in that paper of the explosion in an electrical subway in Pearl street, says it is due to a gas leak that he has been complaining of for forty years.

Mr. D. M. Steward, of the D. M. Steward Manufacturing Company, of Chattanooga, Tenn., was in New York during last week, en route to the Chicago convention. Since the removal of the company from Cincinnati to Chattanooga, he reports, the business of the company in the manufacture of lava insulators, etc., has increased many fold.

Mr. E. N. Dickerson, counsel in this city for the American Bell Telephone Company, denies the reports as to a proposed intention of that company to compete for business with the Western Union Company. At the same time he admits that the long-distance service is being very rapidly pushed, although it does not include "written messages."

Mr. J. H. Shay, representing the Charles Munson Belting Company, of Chicago, has again been compelled to make a flying trip East, in consequence of the tremendous development of the business of the concern in this section in connection with electric light and power plant. Mr. Shay has recently taken some of the largest orders ever given east of Chicago for central station work, and sees even larger ones ahead.

Mr. H. M. Byllesby, owing to the heavy pressure of work in connection with the Westinghouse business at Pittsburgh headquarters, has been compelled to resign his position as general manager of the Sawyer-Man Company. Mr. P. H. Alexander has been promoted to the general managership, and has fairly earned the post by the unparalleled results he has achieved in the active conduct of the business, as cited in the annual report just presented by Mr. Westinghouse.

Mr. Walter C. Wonham, manager of the Eastern office of the Hill Clutch Works, reports that the business is constantly increasing, and that they have recently booked orders for their clutch pulleys and couplings and power transmission machinery from the following points: Dolgeville, N. Y.; Buffalo, N. Y.; New Brunswick, N. J.; Boonton, N. J.; Wilmington, Del.; Newark, N. J.; Schenectady, N. Y.; Boston, Troy, Peabody, Mass.; Lawrence, Mass.; Ocean Grove, N. J.; Baltimore, Md.; Baldwinsville, N. Y.; Albany, N. Y., and have also booked orders from the Lehigh Valley Railroad Company, F. W. Ehrsam, the Palmer Manufacturing Company, the Gardiner Electric Light Company, Fitchburg Steam Engine Company, the Narragansett Electric Light Company, the Robinson-Foster Electric Railway Motor Company, the Derby Gas Company, Hewes & Phillips Iron Works, Cooke & Co. and Benjamin Eastwood.

MISCELLANEOUS NOTES.

Westbrook, Me.—S. D. Warren & Co. are experimenting with electric bleaching.

Ohio is likely to have executions by electricity, the bill for that purpose having passed the State Senate. Missouri now proposes also to adopt electricity.

St. Louis.—The St. Louis *Merchant, Miller and Manufacturer* advocates the holding of an electrical exposition in that city, and "hopes the board of directors of the St. Louis Exposition will take the same into consideration."

Electric Sugar.—It may interest any one who holds stock of the Electric Sugar Refining Company to know that in 1848 a patent was granted to Mr. Clement for "the rarification of sugar by electricity." There is, however, no data as to the fortune Mr. Clement accumulated by his invention.

An Electrical Romance.—The most interesting of all the novels called forth by modern researches among the unknown powers is "A Romance of Two Worlds," by Miss Marie Corelli. In this story electricity is the occult power, which, in the hands of a learned Italian, frees the soul and enables it to promenade among

the stars. The rare merit of the book is that improbability is not only made to wear the semblance of probability, but the style of the book is elevated and refined, and the characters are finely sustained. —*N. Y. Sun.*

Not Struck by Thunder.—A lady teacher who tells the story was in the habit of giving her small pupils talks on various topics, scientific, historical, or general, and then calling on some one of them at a subsequent time to give her the story as she told it to them. One day the State Superintendent came in, and among other classes called was the class of little fellows to whom she had been giving these talks. She had but recently given them the story of the capture of Quebec, and, as they had all seemed to be much interested, she concluded to have one of the little ones give her the story. So one of them began telling all about the situation and how the English had stealthily scaled the Heights of Abraham. "And," said he, "when the French saw what had been done they were struck by lightning." "Struck by lightning?" exclaimed the amazed teacher. "Yes, marm," said he, "you told us that they were struck by thunder. But then you know you told us one day that thunder never struck anybody. So we concluded you made a mistake and meant they were struck by lightning." She had told them that the French were thunderstruck.—*Chicago Advance.*

BUSINESS NOTICES.

The Canton Steam Pump Company, of Canton, Ohio, shipped in one day recently 117 pumps. This shipment included pumps for nearly all parts of the globe.

The Okonite Company advertise their well-known insulated wire specialties in this issue in a page which furnishes an excellent idea of some of their large manufacturing facilities.

C. R. Vincent & Co., of 15 Cortlandt street, New York, call special attention in this issue to the Manning vertical boilers which they make and sell, and which are warmly recommended for electric light plants.

A Souvenir.—We are in receipt of a very handsome "souvenir" from E. P. Bullard, 72 Warren street, manufacturer of machinist's tools, cold rolled shafting, pulleys, hangers, etc. It makes a convenient reference for dynamo and motor builders, and for constructors of all classes of electrical machinery.

Patterson, Jordan & Gottfried, 146-150 Centre street carry a complete stock of brass and iron machine and wood screws, cap and set screws, all kinds of bolts, taps, files, twist drills, brass and rubber tubing, brush copper, rod and sheet copper, brass rod, sheet German silver, sheet brass, machinery, tools, hardware, etc. Electric motor supplies.

Crowdus Batteries.—Although the Crowdus batteries made by the Electric Fare Box Company have been offered on the market for a short time only, they are growing very popular, which speaks much for their merits. This company will have an exhibit of their goods at the Chicago convention under the management of the Knapp Electrical Works.

The Curtis Regulator Company, of Boston, Mass., are in receipt of a letter from the Bagley & Sewall Company, Watertown, N. Y., in which they state: "We are perfectly satisfied with the water pressure reducing valves furnished by you, and intend to continue their use. We tried a number of others, and are satisfied that your's are the best for our purpose."

M. Henry D. Hall, formerly of the Railway Telegraph Company, has recently become connected with the Empire Electric Company, 15 Dey street, of this city. Mr. Hall would be pleased to hear from any of his old friends needing electrical supplies of any description. He says "that the Empire Company cannot be beat for quality of goods or prices," and that "their manufacturing facilities are A No. 1."

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS ISSUED FEBRUARY 12, 1889.

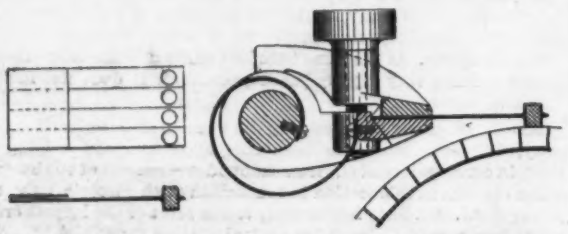
397,489. Method of Protecting the Negative Plates of Electric Batteries; Francis J. Clamer and Joseph G. Hendrickson, of Philadelphia, Pa. Application filed June 23, 1888. The negative plate of the battery is coated with lead.

397,492. Brush for Electric Generators; Rudolf Eickemeyer, Yonkers, New York. Application filed Oct. 17, 1888. The plate or brush spring is provided with a set or series of projecting carbon blocks which are arranged in a line and are slightly separated from each other for affording a free circulation of air not only between the brush plate and the revolving conductor, but also between each of the carbon blocks. See illustration.

397,526. Galvanic Battery; C. M. Thompson, Brooklyn, N. Y. Application filed Oct. 7, 1887. A galvanic battery, the electro-positive electrode of which is immersed in a solution of a suitable chloride, preferably chloride of magnesium, for an exciting fluid, and the electro-negative electrode of which is immersed in a solution of chromic acid with sulphuric acid, preferably a solution containing twenty per cent. of crystallized chromic acid in fifty per cent. of water, with thirty per cent. of sulphuric acid to diminish the internal resistance and act gradually to decompose the chloride and release chlorine to unite with the zinc for a depolarizing agent.

397,538. Electric Meter; H. H. Cutler, Newton, Mass. Application filed June 25, 1888. The device employed for measuring the quantity of current consists, essentially, of two wires substantially similar to one another in diameter, length and material, and subjected to equal tension in the direction of their length, one only of which wires is traversed by the current to be measured, and is thus heated and caused to expand by the current flowing through it, the amount of said expansion varying with the amount of the current. The said wires are connected with a pivoted yoke or lever provided with a pointer, which yoke is caused to rock on its pivot, producing a movement of the pointer as the length of one wire relative to the other changes.

(1) 397,550. (2) 397,857. (1) Dynamo-Electric Machine; (2) Apparatus for Heating Cars by Electricity; R. M. Hunter, Philadelphia, Pa. Applications filed July 14, 1888, and Jan. 12, 1887. 1. In carrying out the invention so far as it relates to the armature, it is made of the Gramme type and elongated. Inside of it is placed a second ring with coils to form an internal field, and this latter ring may be wound like a Gramme or drum



397,492. BRUSH FOR ELECTRIC GENERATORS.

armature. Both of these rings are secured to the same frame and revolve together as an integral piece of apparatus. The operation is such that as the armature and internal field coils rotate their poles shift also and the internal field magnetizes the internal wire of the armature and greatly increases its inductive effect and enables heavier cores to be used. 2. An electrically propelled vehicle, an electric motor to propel said vehicle, an electric heater to heat said vehicle, a source of electric energy, and electric circuits including said motor and heater in multiple arc connection.

397,553. Electric Coupling for Railway Train Signaling; W. C. Johnston, Jr., Lynn, Mass Application filed March 5, 1888. This coupling consists of a shell or case and a flanged tubular section of flexible material for inclosing the wires A screw cap is provided for securing the tubular section to the casing.

(1) 397,557. (2) 397,729. (1) Secondary Battery Plate; (2) Automatic Switch for Electric Arc Lamps; Edward R. Knowles, Brooklyn, New York, Assignor to the Mutual Electric Manufacturing Company of New York. Applications filed respectively Oct. 29, 1888, and Sept. 24, 1885. (1). The plate is made of two separate castings riveted together. Upon one of the castings the fastening rivets are cast together with side lugs for supporting the adjacent plates. The other casting with holes to receive the rivets and with lugs to support the plate as also the connecting lug at the top. The said lugs on the alternate plates face in opposite directions and a cross-bar is inserted between them so that one series of plates is supported by the other. The cross-bar together with a separating comb form important parts of the invention. They are made of soft flexible insulating material. The cross-bars have annular flanges which prevent side movement of the plates. See illustration. 2. This invention relates to a de vice for use in multiple carbon electric arc lamps for the purpose of automatically switching the current from one pair of carbons, when consumed, to the next, so that a lamp can be kept burning for a long period of time.

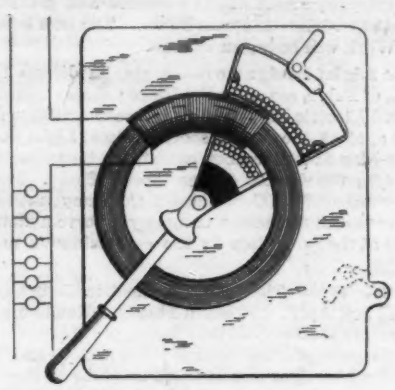
397,607. 397,608. Electrode for Secondary Batteries; L. Paget, New York, N. Y., Assignor to the Macraeon Storage Battery Co., of same place. Applications filed Oct. 23 and Nov. 3, 1888. The object of these inventions is to produce the active material and a support or grid during one and the same operation. It consists in fusing a metallic substance which possesses electrical storage properties, and then subjecting the same to the action of a properly disposed reducing agent, which causes the metallic base to assume the position and shape of a grid carrying the residual substance in the nature of active material. See THE ELECTRICAL WORLD, Feb. 9, 1889.

397,613. Regulation of Dynamos; E. W. Rice, Jr., Lynn, Mass. Application filed July 26, 1888. The bank or battery of dynamos comprising two or more dynamos having their armatures connected in multiple to the main through exciting coils, equalize the connections between the armature circuits, and separate field exciting coils of constant effect supplied in multiple from wires fed by the separate generator.

397,616. Regulating and Motive Device for Alternating Currents; Elihu Thomson, Lynn, Mass. Application filed July 26, 1888. An alternating current motive or regulating device consisting of an iron core of endless form or inclosed magnetic circuit and two electric conductors encircling the same, the parts being properly mounted, to permit change in the inductive relation of the two circuits or conductors.

397,650. Secondary Battery; W. Kingsland, Gunnersbury, England. Application filed June 4, 1888. Patented in England April 22, 1887, No. 5,867. Contact pieces of platinum foil are clamped on to the anode by nuts or bolts.

397,657. Automatic Alarm Apparatus; E. Meyer, Ottleben, Prussia, Germany. Application filed Nov. 3, 1888. Claim 1. An automatic alarm apparatus comprising a three-armed lever fulcrumed on a plate horizontally movable in a fixed

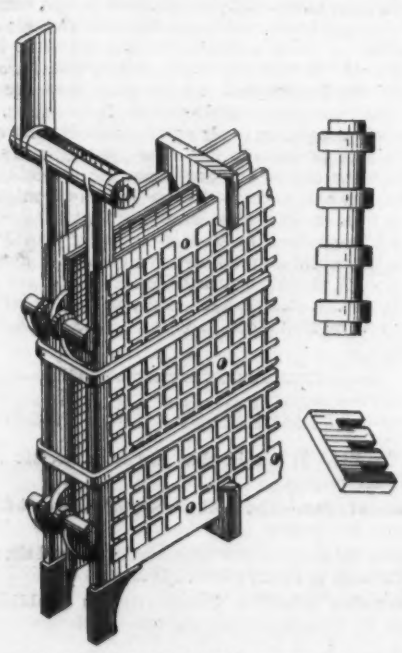


397,616. REGULATING AND MOTIVE DEVICE FOR ALTERNATING CURRENTS.

support, a rotary stud carrying a disc intermittently engaging said lever, contact levers above and below said plate and actuated by said lever, two electric circuits, each containing a battery and alarm bell and closed and opened by said levers, and means for automatically restoring the levers to normal position.

397,702. Electric Motor; Julian F. Denison, New Haven, Conn. Application filed Oct. 15, 1888. A resistance for electric motors, composed of several coils, each coil having a contact independent of the contacts of the other coils, the several contacts adapted to move in the same path, and so as to present a broken or interrupted surface, a stationary contact against which the several resistance coil contacts will successively bear as the said contacts move, a key arranged to slide at right angles to the path of movement of said resistance coil contacts, and mechanism between the resistance contacts and the key to interlock the contacts with the key, and whereby the key can only be moved to open or close the circuit when the resistance is fully applied. See THE ELECTRICAL WORLD, Jan. 19, 1889.

397,705. Method of Winding Field Magnets; Thomas A. Edison, Llewellyn Park, New Jersey. Application filed Sept. 15, 1888. Method of winding a magnet which consists in placing a



397,557. SECONDARY BATTERY PLATE.

cylinder on the magnet core and turning said cylinder to wind the wire thereon.

397,715. Safety Device for Electrical Circuits; William J. Hammer, Boston, Mass. Application filed Nov. 19, 1886. The combination with a broken conductor of an electric circuit, of two or more fusible safety catches, all connected in parallel circuit with one terminal of said conductor, and a switching device for connecting the other end of any one of said safety catches with the other terminal of said conductors.

397,754. Electric Light Carbon; Henry S. Rheiner, Camden, N. J., Assignor of one-half to David K. Joslin, of same place. Application filed Dec. 10, 1888. A carbon electrode composed of carbonized cocoanut shell, marl and an adhesive material.

397,773. Regulating Switch for Electric Motors; H. H. Blades, Detroit, Mich. Application filed March 23, 1888. The object of the invention is to provide a switch of such construction that when actuated by means of a foot lever or other suitable mechanism current may be admitted to the motor, and by further operation of the same more current may be admitted until the motor has attained its maxim current, when by further movement of the switch this maximum current may be shunted through the armature in the reverse direction, thus exerting its full force to stop or reverse the motion of the motor; or by returning the switch to its normal position simultaneously with the reversal of the current, the current may be cut out from the armature and the armature instantly stopped.

397,790. Electro-Magnetic Attachment for Eyeglasses; Fred. Fear, New York, N. Y. Application filed May 1, 1888. The invention consists of a nose-guard, composed of springy metal, preferably magnetic, wound with an insulated electrical conductor, having the ends electrically connected with the nose guard. One end of each of the pieces forming the nose guard is mounted with a metallic plate, one being electro-positive to the other.

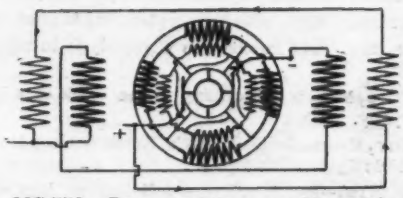
397,796. Storage Battery Plate; Charles D. P. Gibson, New York, N. Y. Application filed Oct. 18, 1888. A storage battery plate consisting of a sheet of metal, having loops raised from its surface and active material covering the surface of the plate and extending under the loops.

397,806. Battery for Electric Belts; W. G. Johnson, London, England. Application filed Oct. 9, 1888. An electric belt or band consisting of the folded negative elements, each having an eye or loop, and inclosing a positive element having a projecting lug, and the spiral wires connecting the lugs with the eyes or loops and serving to articulate the elements, to conduct the electric current and permit the pairs of elements to move to and fro and assume various positions.

397,817. System of Synchronizing Electric Motors; F. J. Patten, New York, N. Y., Assignor to J. M. Seymour, of same place. Application filed Sept. 12, 1888. The invention in its broadest sense consists in the use of induced or comparatively high tension currents on the line, said currents being used to produce simultaneous reversals of magnetism in one of the elements of the electric motors.

397,826. Electric Switch; A. E. Andrews, Hartford, Conn., Assignor of one-half to Geo. I. Cornwall, of same place. Application filed June 18, 1888. This is a form of "snap" switch.

397,838. Electric Signaling and Alarm Apparatus; W. L. Denio, Rochester, N. Y. Application filed Dec. 1, 1887. The invention consists of a heat detector adapted to be used in the ordinary push button in lieu of the "push" commonly used there-



397,550. DYNAMO ELECTRIC MACHINE.

in, which serves the dual purpose of acting as the push button and of automatically turning in an alarm on the outbreak of a fire or a definite rise in temperature.

397,875. Overhead Line for Electric Railways; Frank J. Sprague, New York, N. Y., Assignor to the Sprague Electric Railway and Motor Company, of same place. The main feature of the invention consists in providing the overhead line with a downwardly extending rib for receiving the groove of the trolley, and causing the same to ride downwardly, so that the flange of the trolley will pass on to the frog or switch plate.

PATENTS EXPIRED FEBRUARY 20, 1889.

123,958. Lightning Rod; D. F. Welse, Nevada, Ohio. Patented Feb. 20, 1872. A lighting rod, each section of which is formed, respectively, from one or two sheets of metal, so bent or fluted that when the side edges of such sheet or sheets are brought together and connected a hollow section of rod of stellate form is produced.

123,878. Telegraph Insulator; D. R. P. Emminger, Harrisburg, Pa. Patented Feb. 20, 1872. An insulator constructed with its outer surface conical or flaring from the apex to the base, provided with the peculiarly shaped and grooved projections.

123,808. Electro-Magnetic Annunciator; C. E. Chinnock, New York, Assignor to Edwin Holmes, of Brooklyn, N. Y. Patented Feb. 20, 1872. This invention has for its object to provide an automatic annunciator for electro-magnetic alarm or call apparatus, and means for establishing currents through audible or other signals whenever the indicator is set in motion. It is intended for use on alarm apparatus to first indicate the locality at which the operating current was established, and subsequently start the alarm.

123,923. Electric Light; A. A. Meynial, New York, N. Y. Patented Feb. 20, 1872. The retrograde lever, having two arms of unequal length, the longer arm to produce the retrograde movement of the positive electrode, and the shorter arm that of the negative electrode, so as to compensate for the increased consumption of the positive electrode in an arc lamp.

123,932. Voltaic Amalgamator for Gold and Silver; J. H. Rae, Syracuse, N. Y. Patented Feb. 20, 1872. The arrangement of one or more voltaic piles in the interior of an amalgamating cylinder.

123,970. Automatic Signal Box for Fire-Alarm Telegraphs; G. Wright, M. Y. Holley and H. R Miles, Washington, D. C. Patented Feb. 20, 1872. The combination with an automatic signal box for fire-alarm telegraphs, a stationary insulated dial plate and in conjunction therewith a revolving metallic spring arm for breaking and closing the circuit, automatically and continuously rotated by means of a weight or spring exerted through a suitable train of gearing.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Potter Building, N. Y.